SCIENCE AND INDUSTRY

The Dock & Harbour Authority

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(Left) SURFACE CONDITION PRIOR TO COMMENCEMENT OF THE WORK.

(Right) HEAVY WELDED FABRIC IN PLACE.

(Left) SHOOTING THE "GUNITE" FACING AT LOW TIDE.

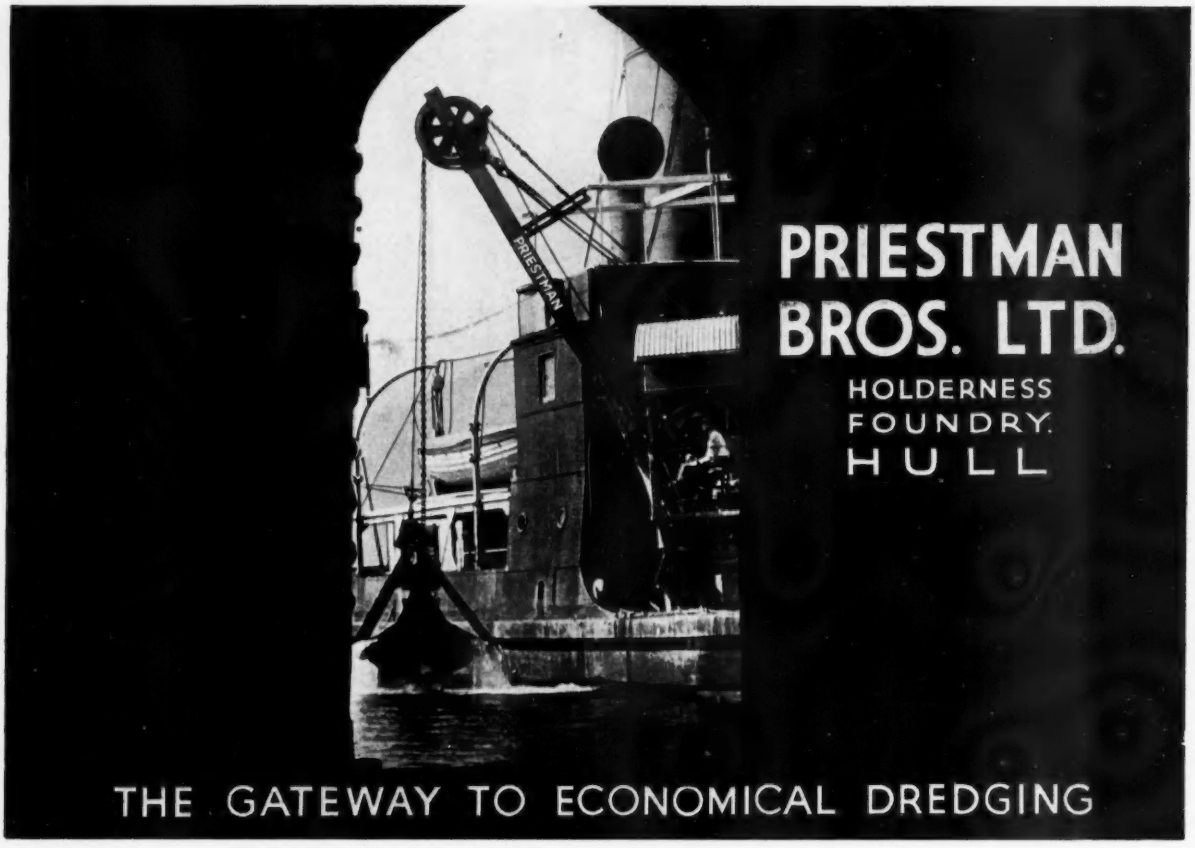
(Right) PORTION OF COMPLETED REINFORCED "GUNITE" FACING.

(Left) INJECTING 1:2 MORTAR NEAR BASE OF WALL.

(Right) INJECTING 1:2 MORTAR NEAR BASE OF WALL.

(Left) INJECTING 1:1 MORTAR INTO MASONRY NEAR TOP OF WALL.

(Right) INJECTING NEAT CEMENT.



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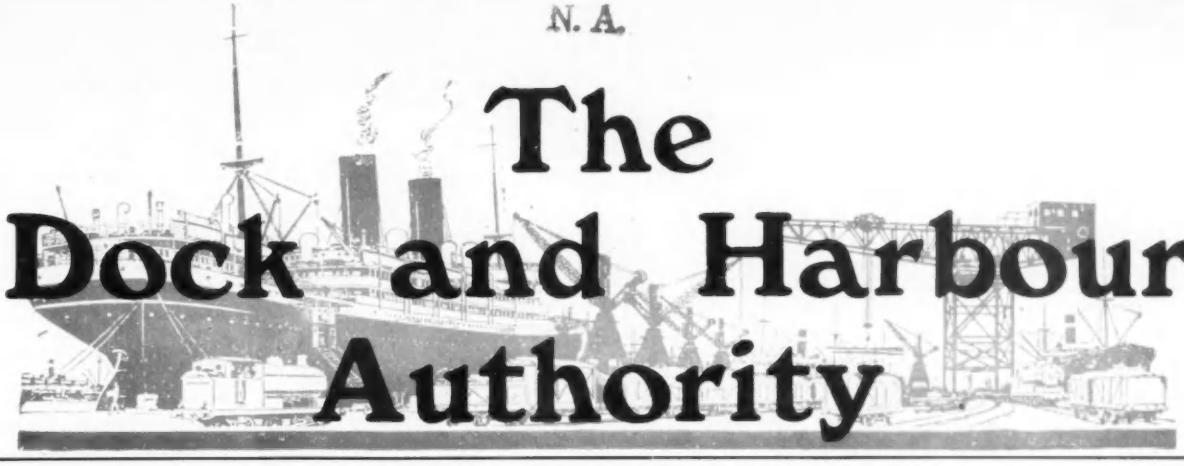

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Editorial Comments

Volume XXIII.

In view of earlier intimations of the restrictions in paper rationing for journalistic use, our readers will not have been unprepared for the reduction in page size of this Journal which takes place with this issue. For a long time we have striven to maintain the familiar aspect of the publication, hoping almost against hope, that it might be possible to meet the limitations imposed by relentless authority by a curtailment in the number of pages, but this expedient has not sufficed to avert the impending blow and, at length, the axe has fallen. The Journal must now appear in abbreviated format. Yet we trust our readers will find no cause for serious complaint. We suffer in common with practically the whole of the press, and other technical publications have taken the step long ago.

Indeed we have to thank our advertising friends, which we do very warmly, for their ready acceptance of the position, as already communicated to them, and for the continuance of their support which is much appreciated. We are encouraged by their attitude and take it as an indication that the Journal has served acceptably in the past as a useful purveyor of information on port affairs. We shall endeavour, as far as we are permitted by the official censorship, to keep port officials, contractors and others in touch with harbour developments in various parts of the world.

With a view to facilitating arrangements for binding, it has been decided to close volume xxii with the preceding issue, and to commence a new volume of the new page size, which is henceforward to be the standard.

Twin Inland Canadian Ports.

Far away in the heart of the North American Continent, at a point near the Westernmost extremity of the Great Lake system, lie two flourishing Canadian ports, which, even if they are remote from the great ocean highways of the world, have nevertheless a considerable degree of importance and carry on a trade, mainly inland it is true, but water-borne, and of a volume which is highly to their credit.

The outstanding feature of the twin ports of Fort William and Port Arthur is their intimate association with the grain trade, which forms so essential a part of the productivity of the three great prairie provinces of the Dominion: Saskatchewan, Alberta and Manitoba. The leading article in the current issue gives detailed particulars of the accommodation available and of the operations at the ports, which may be said to form a serviceable sequel to the interesting Paper by Mr. Cecil Bentham on the Transportation of the World's Grain Harvests, published in the issues of this Journal for Jan., Feb. and Mar., 1939 (vol. xix).

With a joint storage capacity of nearly 2½ million tons, the grain handled through the two ports annually is very considerable and forms a substantial contribution to the cereal needs of European countries; but leaving aside this paramount activity, we are tempted to look at a possible future aspect of trade development at these ports which has not hitherto figured to any extent before the public eye.

The most pressing demand of the nations of the world at the present time is for oil: oil in ever-increasing quantities for the purpose of waging war, and in peace time for the maintenance and expansion of vehicular transport. Now the world supplies of petroleum, though enormous, are not inexhaustible, and are annually being depleted at an ever-increasing rate. The present oil reserves of the world, so far as can be ascertained, are estimated at about 25 thousand million (or, in American computation, 25 billion) barrels, of which some 20 thousand million barrels are to be found in the United States. Indeed, 60 per cent. of actual supplies come from the States, the next largest source being Russia to the extent of 10 per cent. Assuming the figures are correct, these visible sources, in the United States, if tapped at the present rate of user, will only be able to provide the needs of 14 or 15 years ahead, so that new sources and reserves must be found if the present consumption is to be maintained thereafter. As fresh discoveries are continually being made, little apprehension is felt at the prospect. Still it is significant.

At this stage, there comes the startling announcement that means have been found for exploiting a vast productive area of many thousands of square miles in Northern Alberta, containing, it is estimated, ten times as much oil as is known to exist in the rest of the world—probably as much as 250 thousand million (or billion) barrels.

A recent article in *South African Engineering*, making this statement, explains that the immense potential oilfield in question has been known to explorers and geologists for a century and a half, and yet has remained undeveloped, because no satisfactory and reasonably economic method has been found for separating and extracting the oil from the sand strata in which it is embedded. American oil engineers have however, as recently as May last year, solved the problem and have actually produced the first few hundred barrels of refined oil.

If this method proves effective, it opens out tremendous possibilities in the expansion of oil transport, both westwards towards the Pacific and South-eastward via the Great Lakes of the Atlantic. In this great movement it seems quite likely that the ports of Fort William and Port Arthur will participate, and so acquire fresh horizons of trade and prosperity.

Editorial Comments—*continued*

The Capetown Dry Dock.

The insistent and increasing demand for the construction of a large new dry dock in connection with the harbour developments now in progress at Capetown, which has been noticed in earlier issues (May and August last year) of this Journal now seems in a fair way to be satisfied. News has been received that estimates amounting to £2,034,000 for a graving dock at least 1,000-ft. long have been tabled in the Union House of Assembly. There is little doubt that the necessary legislative sanctions will be given and that the work will be proceeded with immediately. It is understood that the British Government is providing machinery and other equipment to the value of about £750,000.

This is the culmination of an agitation which has been going on for several years. Hitherto the South African Government, while recognising the desirability of a graving dock capable of receiving ships as large as the *Queen Elizabeth* and the *Queen Mary*, has felt compelled to postpone execution of the project in view of the heavy financial commitments in regard to other items of port development. But the need could not be ignored and has, indeed, become urgent, it being alleged that ship repair contracts have been lost for lack of adequate dry dock accommodation. This is not surprising in view of the fact that the largest dry dock existing at the port has dimensions of only 500-ft. in length by 68-ft. entrance width with 26-ft. of water on sill.

The Port of Durban possesses a graving dock of the calibre desired at Capetown, but the distance of nearly a thousand miles from one port to the other makes it too remote for practical purposes and, in any case, it is unworthy of the prestige of Capetown that it should be unable to provide up-to-date repairing facilities for large vessels visiting the port, especially in war time.

Unfortunately, no matter how expeditious may be the preparations and however rapidly the work be carried on, it seems scarcely likely that the dry dock can be completed in time for use during the present war.

Capstan Work at the Quayside.

Among the less prominent mechanical appliances in use at the quayside are capstans, both of the hydraulic and electric type. Their function in general is that of shunting and manœuvring railway wagons alongside ships for the purpose of receiving or discharging cargo. Indeed, they are really, a branch of railway work transported to the dockside in order to carry on there processes of a similar character, though on a slightly different scale and with more restricted scope. None the less, they constitute an extremely valuable equipment, and ports with extensive rail traffic would find it difficult, if not impossible, to dispense with them.

As their fullest land use may be said to be in connection with rail-borne traffic, it is not surprising that their modern development is largely due to the initiative and enterprise of the railway companies, and it is fortunate and appropriate that we should have secured the services of Mr. J. Dalziel, formerly assistant electrical engineer to the London Midland and Scottish Railway to discuss the merits of the various types of capstan in regard to their utility for dock work. The current number contains the first instalment of an article which will place the experienced outlook of the author at the service of our readers.

The St. Nazaire Exploit

The amazing adventure, resulting in the disablement and probably complete destruction of the outer caisson, with damage to the pierheads, of the new dock entrance at the French port of St. Nazaire, by the joint action of British sea, air and land forces on March 28th last, has naturally attracted attention to the structural aspect of the target, though some of the alleged features described in the non-technical press may well have provoked a smile, as, for instance, the statement that the " lock gates were 30-ft. *thick*." (The italics are ours).

So far as can be gathered from well-informed sources and official reference books, the installation concerned is the new lock at the entrance-passage to the Bassin de Penhouet, which has a total length of some 2,000-ft., though the lock chamber itself, which is capable of being used as a dry dock, is limited to a length of 1,148-ft., with an internal width (at coping level) of 164-ft. and a depth of water over sill at H.W.O.S.T. of 44-ft.

The lock chamber is closed at each end by a sliding caisson, the outer one being that which was demolished by the impact of the destroyer, *Campbeltown*. At any rate, the caisson has disappeared and little credence will be given to the Nazi allegation that it had been withdrawn into its side recess previous to the raid. In any case, the detonation of a 5-ton mass of explosives must have made havoc not only to the caisson itself, but of the caisson chamber and the pierhead structures, including the sill. Aerial photographs taken after the raid, indicate that the pump house has been demolished and the operating machinery wrecked.

Obviously, the Nazis are now deprived of the use of the new dry dock, which could accommodate their largest battleship, the *Tirpitz*, and this deprivation must extend for a long and indefinite period. Moreover, for the present, access to the Penhouet Basin must be restricted to the alternative entrance, via a lock from the outer harbour. This lock has a chamber with maximum length of 692-ft. and a width of 98½-ft., the depth of water over sill being 33½-ft. at H.W.O.S.T. This is certainly ample for moderately sized vessels, but it does not afford facilities for ship repairs, as in the case of the combined dry dock-lock.

The inner dock level at St. Nazaire has been maintained at constant height with, at least, 27-ft. of water in the Bassin de St. Nazaire and of 26¼-ft. in the Bassin de Penhouet, by means of recently installed pumping plant, which is believed to have been included in the devastation wrought on March 28th.

The whole exploit redounds greatly to the credit of British arms, and adds new laurels to the services which took part in it.

Future German Port Policy.

It is always profitable to " learn from the enemy " (*ab hoste doceri*) and so we make no apology for giving consideration to a paper on future port planning presented at a recent meeting of German shipbuilding and engineering societies held recently at Dusseldorf. Dr. Bolle, of Hamburg, the author of the paper, made the somewhat platitudinous introductory observation that even in normal times it was necessary to consider likely changes or increases in traffic when making plans for extending port equipment, to which he added that, after the war, an especially intensive examination of these matters would be required. New targets would be set up for practically all ports. The first point for attention was the utilisation of all existing equipment to the best possible advantage. New construction was mostly needed to deal with, or attract, new business, as also to handle future increases in traffic. There should be reserve provision in this direction, but extremes should be avoided.

Shipbuilding developments had to be borne in mind. It seemed to him likely that after the war there would be restrictions on the types of ships produced and if, for instance, the cargo vessel of about 9,000 tons were chosen as the largest type of regular freight carrier, that would naturally have an effect upon the dimensions of port works. The speaker considered it satisfactory that for inland navigation in Germany, it had been decided to limit new vessels to nine types. In all countries where such a course was possible, it must be anticipated that there would be increased use of inland waterways as a cheap means of communication, and the seaports must, therefore, be equipped to deal with more inland traffic; in this respect, the efficient cargo-handling gear of the modern ship would facilitate transhipment in the river, thus easing the demand for quayside berths.

Two other feeder services, Dr. Bolle continued, would also greatly influence the lay-out of ports: railways and motor lorry traffic. Points to be noted included the greater mechanisation of shunting, the provision of spacious areas for the parking of vehicles and adequate ramps and platforms for dealing with lorries. Special attention should also be paid to mechanical equipment, as ports with rapid despatch arrangements always received preference. It often happened, he averred, that capacity could be increased more quickly and cheaply by providing modern mechanical equipment than by undertaking new works.

Some of Dr. Bolle's observations will seem pretty obvious to English port officials, but it is interesting to have an expression of German views on such matters, and his allusion to the probable greater utilisation of inland waterways should be pondered over in this country, where, in the past, canal traffic has suffered greatly from neglect.

Two Canadian Grain Ports

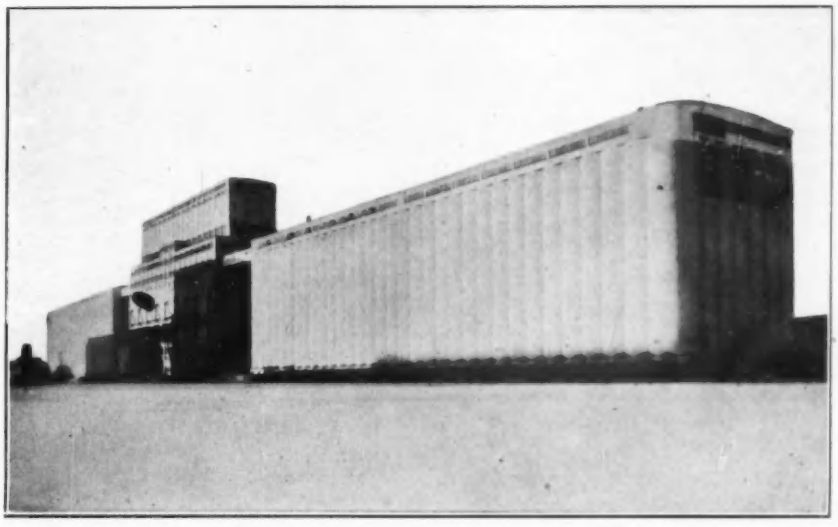
Termini of a Great System of Inland Navigation

Location and Functions

SITUATED some two thousand miles inland from the Atlantic Ocean, at the head of the vast inland linked seaway, known as the Great Lakes of North America, are two Canadian ports, Fort William and Port Arthur, which fill an important role in the supply of grain to Europe and, in particular, to Great Britain. Many millions of bushels of grain, harvested annually from the adjacent Canadian provinces of Manitoba, Saskatchewan and Alberta are collected and stored in silos at the two cities, for subsequent shipment into vessels which convey their freights by water, either to their ultimate destinations or to some intermediate port for transhipment abroad.

Both ports, with a distance of only 3 miles between them, so that they are regarded as a single entity for the administration of the Canada Grain Act, lie within Thunder Bay, a sheltered coastal inlet on the North side of Lake Superior, the westernmost and largest of the group of lakes, with an area of 31,800 square miles and a mean depth of 688-ft. The "Lakes" are, strictly speaking, inland seas, and the extent of their economic importance may be gauged from the fact that the population along their shores is greater than that in the regions bordering on the Mediterranean.

Although closely associated and jointly administered, the ports call for description separately. Fort William with a population of 26,000 is rather larger than Port Arthur, where the inhabitants number only 20,000, and will accordingly be taken first.

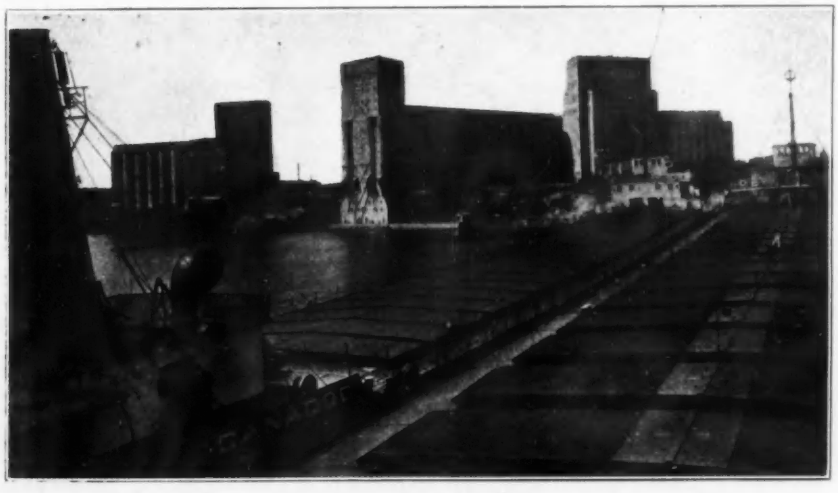


Canadian Terminal Elevator in Fort William—Port Arthur District.

FORT WILLIAM.

Physical Features

Fort William is situated at the mouth of the Kaministikwia River on the West side of Thunder Bay, within a short distance of the Canadian-United States boundary. The river possesses a deltaic embouchure, providing two main approach channels to the port. The principal entrances, the Kaministikwia channel, is 600-ft. wide with a depth of 25-ft.; the other, the Mission River channel, with the same depth is 500-ft. The McKellar River provides a third subsidiary channel.



Grain Steamers on Great Lakes.

The natural controlling depth in the outer approaches is limited to 21-ft. at low water level in the lake. Dredging operations, however, have increased the depths in the various channels, at the berthage and in turning basins to 25-ft. The largest vessel to berth at the port hitherto has been the ss. *Lemoyne* of 10,480 tons gross, with dimensions, 621-ft. by 70-ft. by 25-ft.

The water front of the harbour extends to 22 miles and is served by 13 miles of dredged waterway. Of this total, a length of 8 miles consists, of a series of wharves and "docks," or, in the English nomenclature, jetties. As there are no enclosed docks in the English sense, it is to be understood that in this article, the term has its American signification of a projecting waterside structure, alongside which vessels can be moored and cargoes handled for shipment or unloading.

The harbour has natural protection, being land-locked, partly by the mainland, and partly by the islands formed by the three entrance channels. Sheltered anchorage is also available on the West side of the Welcome Islands, 4½ miles from Fort William, where there is good holding ground in depths ranging from 5½ to 12 fathoms.

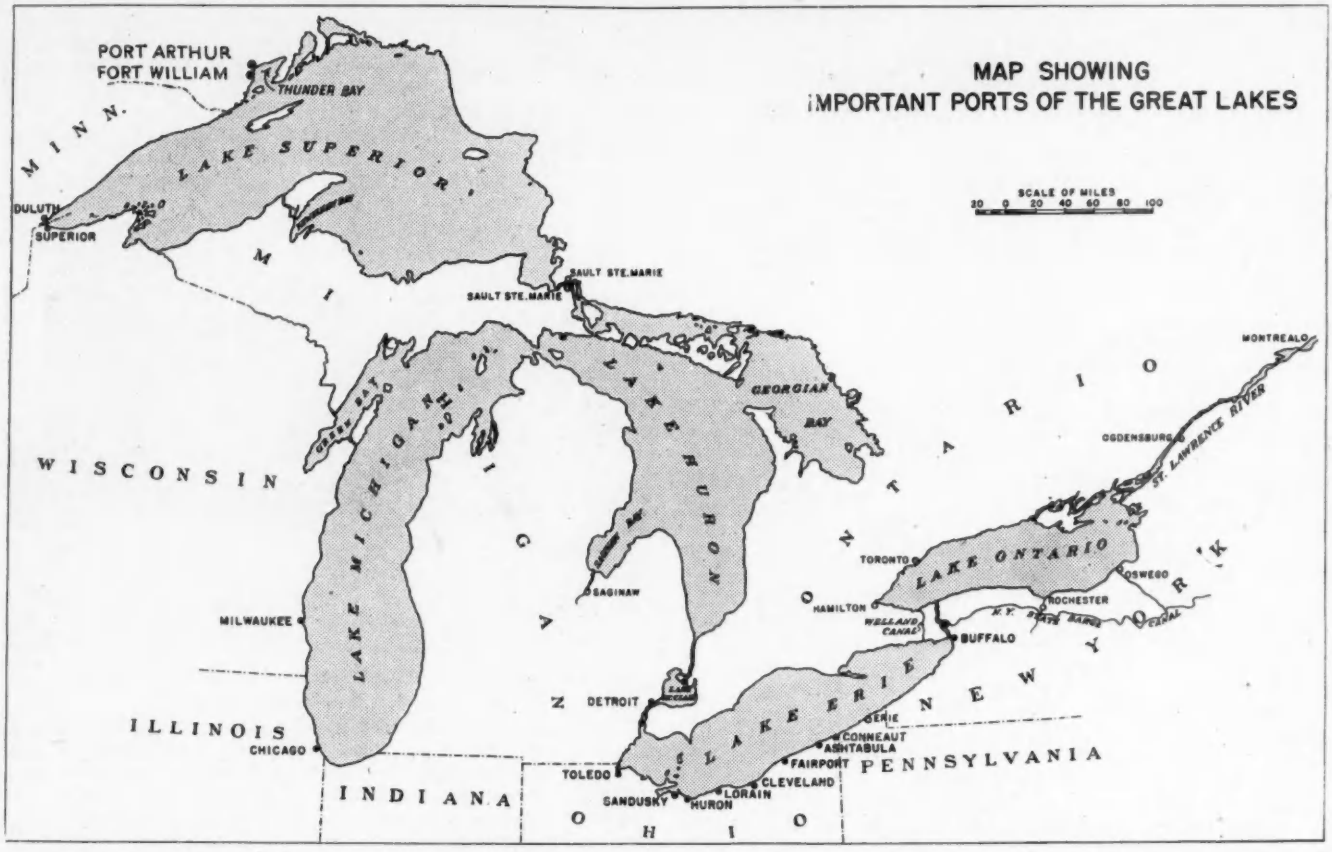
Trade and Industry.

The principal activities of the port are connected with the export of grain, flour, lumber (timber logs), pulp and paper, together with the development of hydro-electric power and the mining industry. The chief imports are coal, oil and general merchandise. The navigation season lasts from mid-April to mid-December after which ice becomes prevalant in Lake Superior. In the harbour, ice can be broken up by tugs. Tugs are also employed for towing and berthing vessels in stormy weather; normally, for power-driven vessels, this is not necessary. Pilotage is not compulsory and pilots are not provided.

Port Accommodation

A detailed summary of the berthage and storage accommodation available at the port is as follows:—

Two Canadian Grain Ports—continued

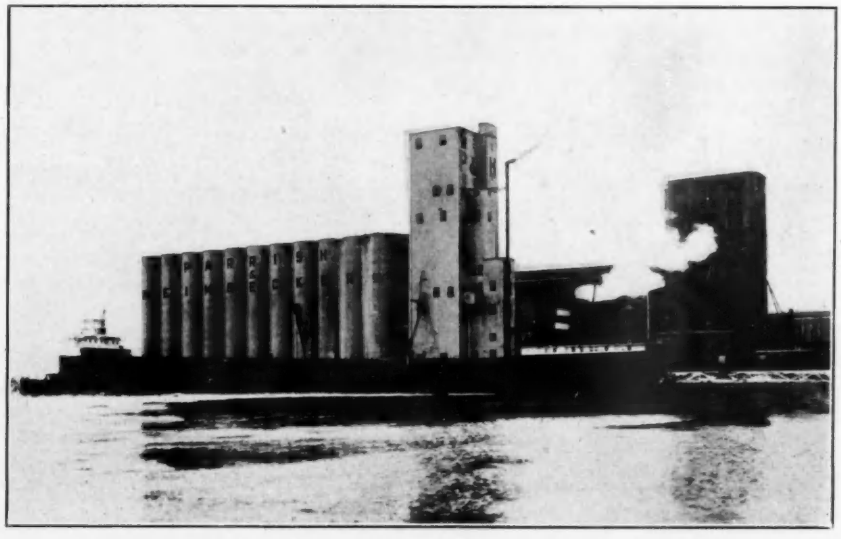


Kaministikwia Channel Berths: (1) Canadian Consolidated Grain Co., Ltd., 2,000 lin. ft.; elevator capacity, 1,750,000 bushels. (2) Imperial Oil, Ltd., 400 lin. ft., oil storage tanks, 500,000 gallons. (3) Canadian Pacific Railroad, coal dock, 1,600 lin. ft., coal storage, 300,000 tons. (4) Canadian Pacific Railroad, freight dock and sheds, Nos. 3, 4 and 5, 2,000 lin. ft., general freight. (5) Federal Consolidated Elevator, 1,000 lin. ft., elevator capacity, 1,750,000 bushels. (6) Federal North-western Elevator, 1,000 lin. ft., elevator capacity, 3,000,000 bushels. (7) C.P.R. general freight dock, 700 lin. ft. (8) City Wharf and Tug Office, 700 lin. ft. (9) C.P.R. freight dock and shed No. 6, 1,500 lin. ft. (10) Ogilvie's Flour Mill dock, 2,300 lin ft., elevator capacity, 3,000,000 bushels, flour shipping wharf. (11) Murphy's Coal Dock, 600 lin. ft., coal storage, 3,000 tons. (12) International Harvester Company's dock, 600 lin. ft. for shipping farm machinery. (13) C.P.R. freight dock and shed No. 7, 450 lin. ft., general freight. (14) Northland Elevator, 600 lin. ft., elevator capacity, 7,500,000 bushels. (15) Western Terminal Elevator, 600 lin. ft., elevator capacity 4,050,000 bushels. (17) Plymouth Cordage Company's dock, 200 lin. ft. (18) Canada Iron Corporation dock, 400 lin. ft., for iron ore. (19) Great Lakes Paper Company, 800 lin. ft., for shipping newsprint paper, pulp, screenings; also for receiving sulphur, limestone, coal; coal unloading tower, 200 tons per hour. (20) Imperial Oil, Ltd., dock No. 2, 300 lin. ft. (21) Robin Hood Flour Company dock, 330 lin. ft., flour shipments. (22) C.P.R. freight dock and sheds Nos. 1 and 2, 2,000 lin. ft., general freight.

Mission Channel Wharves: (1) Grand Trunk Pacific Elevator, 2,000 lin. ft., elevator capacity, 5,500,000 bushels. (2) Searle Terminal Elevator, 1,100 lin. ft., capacity 5,000,000 bushels. (3) Fort William Coal Dock, 1,200 lin. ft., coal storage. (4) Detroit Sulphite Company's dock, 300 lin. ft., shipment of pulp. (5) Fort William Starch Works dock, 200 lin. ft. (6) McColl-Frontenac Oil Co.'s dock, 100 lin. ft., oil storage and pipe line.

McKellar Channel Wharves: (1) Great Lakes Dredging Company, 400 lin. ft., repair yard for shipping. (2) C.P.R. Coal dock, 2,000 lin. ft., coal storage, 2,000,000 tons.

The Great Lakes Lumber Company have recently completed the construction of a large saw mill at the harbour entrance, with wharfage accommodation for the shipment of lumber in Great Lakes and ocean-going vessels.



Canadian Terminal Elevator in Fort William—Port Arthur District.

Two Canadian Grain Ports—continued

All the foregoing wharves and docks in the port are served by railway sidings connected with the Canadian Pacific and Canadian National Railways. Cargo handling equipment includes steam and electric hoists and cranes, with water mains and electric light and power.

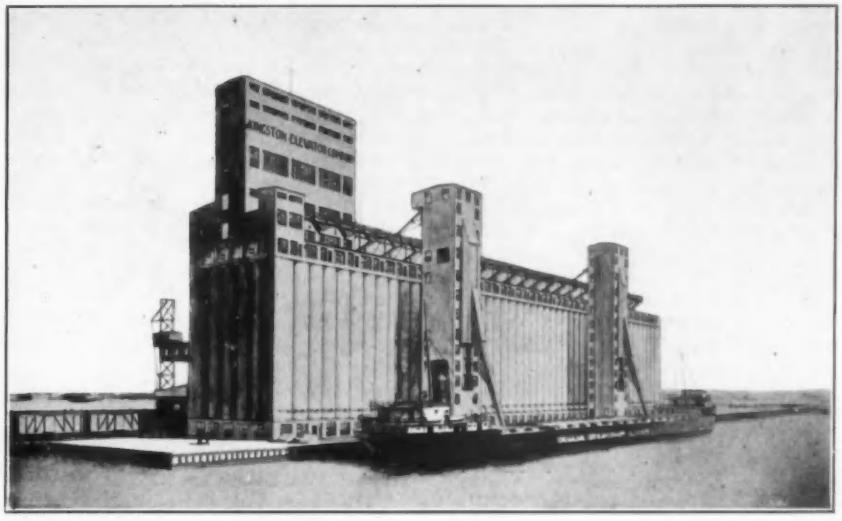
Foreign shipping coming from the Atlantic secure Customs entry and pratique in Quebec or Montreal.

Repairing Facilities

There is a floating dock, 100-ft. long by 70-ft. wide with 16-ft. 6-in. maximum draught for vessels over keel blocks. The lifting capacity is 1,200 tons.

PORT ARTHUR

Situated likewise on the West side of Thunder Bay, Port Arthur lies in a more open position, and the harbour front faces the Bay, but is protected by extensive breakwaters. There are 7 miles of shore line, of which 4½ miles are occupied by wharves and slips.



Canadian Terminal Elevator, Lake Ontario.

The controlling depth of water which obtains alongside the principal wharves is 25-ft.; this is the maximum depth over the sills of the Sault Ste Marie Canal. The actual depth in Port Arthur channels is 26-ft. As in the case of Fort William, the largest vessel using the port hitherto has been the ss. *Lemoyne* with a laden draught of 19½-ft.

The navigation season extends from mid-April to mid-December.

Trade and Industry

Like Fort William, Port Arthur is mainly concerned with the grain trade and its associated products. The gross capacity of the 31 grain elevators in Port Arthur and Fort William is nearly 93,000,000 bushels—this is the greatest elevator capacity in the world up to 1940, the record having been maintained since 1922. The distinction is challenged, but not yet surpassed by Minneapolis and Saint Paul in the United States, the world's largest milling centre. On May 4th, 1934, the elevators in the two Canadian ports had 87,370,451 bushels of wheat, oats, barley, flax seed and rye in storage. During the crop year 1928-29, the same two ports shipped into vessels 293,435,687 bushels of wheat and 40,237,312 bushels of barley. During the same crop year 410,431,963 bushels of grain were received from Western sources and on October 2nd 1928, 2,748½ car loads of grain, totalling net 3,794,208 bushels were unloaded at the two ports. The maximum quantity of grain shipped in one day (November 29th, 1928) was 6,395,814 bushels. The heaviest cargo of grain was shipped on July 26th, 1929, when the ss. *Lemoyne* left port with 571,796 bushels weighing 12,920 tons.

In addition to its grain shipping industry, Port Arthur has shipbuilding yards, foundries, machine shops and other manufactories.

Loading grain into craft on Great Lakes.

Port Accommodation

The following are the leading particulars of the available berthage:—

(1) Canadian National Railway dock and shed No. 1, berthing length, 946-ft.; three sheds respectively 677-ft. by 53-ft., 175-ft. by 40-ft. and 140-ft. by 40-ft., constructed of wood and galvanised iron, used for general freight. (2) Canadian National Railway dock and shed No. 2, berthing length, 768-ft., shed 660-ft. by 60-ft. of wood and galvanised iron, used for general freight. (3) Canadian National Railway dock and shed No. 3, berthing length 650-ft. (including Booth Dock, 1,074-ft.), shed 398-ft. by 60-ft., of wood and galvanised iron, used for general freight. (4) Canadian National Railway No. 3, open shed, berthing length 311-ft., used for steel rails and barbed wire fencing, served by two tracks. Sheds on docks Nos. 1, 2 and 3 have continuous doors on dock side and track side doors, 40-ft. apart; all sheds are lighted by 200-watt drop lights and protected by Areo Alarm System. Dock and shed No. 2 has also automatic sprinklers fitted. Freight is mainly handled by trucks, but a portable crane is available at No. 3 open dock. (5) Canadian Pacific Railway dock, berthing length, 1,000-ft., shed 400-ft. by 53-ft., used for general freight; two rail tracks and cargo hoist hoist with electric light. (6) Eastern Terminal (Richardson's) berthing length, 1,329-ft., concrete elevator, 5,500,000 bushels capacity. (7) Saskatchewan Pool Terminals No. 4, berthing length, 1,280-ft., concrete elevator 6,565,000 bushels capacity. (2) Saskatchewan Tool Terminal No. 5, berthing length 1,280-ft., concrete elevator, 2,100,000 bushels capacity. (9) Saskatchewan Pool Terminal No. 6, berthing

Two Canadian Grain Ports—continued

length 1,000-ft., concrete elevator 7,400,000 bushels capacity. (10) Saskatchewan Pool Terminal No. 7, berthing length, 1,000-ft., concrete elevator, 6,900,000 bushels capacity. (11) Manitoba Pool Elevator No. 1, berthing length 840-ft., concrete elevator, 1,300,000 bushels capacity. (12) United Grain Growers Terminal, berthing length, 1,000-ft., concrete elevator, 5,500,000 bushels capacity. (13) Union Terminals, berthing length, 650-ft., concrete elevator, 5,000,000 bushels capacity. (14) Reliance Grain Company, berthing length, 1,000-ft., elevator, 3,550,000 bushels capacity. (15) Stewart Terminals, Ltd., berthing length, 700-ft., elevator, 2,250,000 bushels capacity.

Recent Trade

From a Canadian shipping journal it is learned that the 1940 shipping season was the best since the pre-depression year of 1928. An increase in tonnage handled to the extent of 20 per cent. in excess of 1939 is reported, for which huge shipments of flour and of iron and steel products were responsible. It is stated that some of the largest shipments ever made were despatched eastwards, by far the greatest part being consigned to English ports. War-time consumption of flour has also increased in Canada.

As regards iron and steel, large cargoes were cleared for Western Canada, surpassing the export of previous years. The majority of these were war supplies and materials for West Coast defence areas and manufacturing centres.

Incoming freights of foodstuffs were also at a level higher than any for fifteen years, though many of the freights came by rail as well as by water. The war, undoubtedly, has had a great effect on the shipping movement and the heavy cargoes of war materials and supplies, as well as the large shipment of food products have been due to this cause.

Traffic at East Canadian Ports in 1941

Shipping Federation Review

At the recent annual meeting of the Shipping Federation of Canada in Montreal, Mr. D. J. S. Tyrer, who, after being vice-president for the past three years, has taken over the office of president for the ensuing twelve months, made the following observations on the activities of Eastern Canadian Ports during 1941:—

He said that, despite abnormal delays and the necessarily restrictive regulations, merchant vessels continued to maintain, effectively, the vital sea transport services, and the highest credit was due to the sea-going personnel of the merchant fleet, the fourth arm of the fighting services. He stressed the importance of the work of wharf staffs and of all shore workers. Shore workers at Canadian harbours had shown they were fully alive to the need for prompt handling of ships, but in some instances there was room for greater effort in speeding up loading operations and thus eliminating delays in dispatching materials urgently required abroad. He called on all for their maximum effort.

During the year the movements of ocean-going vessels were subject to the changing conditions of warfare, and diversion of ships from one route to another was a matter of common practice. Eastern Canadian ports continued to handle a heavy volume of import commodities required for the war effort or for essential supply to the civilian population, while vessels bound from their shores were loaded to capacity with munitions and food supplies for the United Kingdom and other parts of the Commonwealth. At Montreal, the total tonnage of ocean-going vessels entering the harbour showed a decline from the previous year, while cargo handlings were also somewhat lower, a situation which arose through a temporary slackening off in port activity in the latter half of the season. Unquestionably, Montreal and other St. Lawrence ports could handle, efficiently, a much greater volume of cargo than that directed through those channels last year, and with increased production he looked forward to a heavier movement in the coming year through St. Lawrence and other eastern seaports.

The first ocean vessel to arrive in the port of Montreal in 1941 docked on April 18th. The last trans-ocean vessel left Montreal on Dec. 3rd, followed, on Dec. 4th, by an inland navigation vessel bound for sea coasting service. The harbour was therefore open, for sea-going ships, for a period of 231 days in 1941. Water levels in the St. Lawrence Ship Channel remained normal throughout the 1941 season of navigation, the level at Montreal being approximately the same as in the previous year. Ship Channel dredging operations were curtailed in the interest of war economy, but a considerable amount of maintenance work was carried out throughout the season. A number of collisions and strandings in the pilotage waters of the St. Lawrence were recorded during the 1941 season of navigation, but, forunately, most of these casualties were of a minor nature.

United Kingdom Pilots' Association

In the latest issue of *The Pilot*, Sir John Inskip, Solicitor and General Secretary of the United Kingdom Pilots' Association, among other matters under review, alluded to the following:—

" The London Pilots' Benefit Fund continues to receive careful consideration, and since my last report there has been a meeting at the Ministry of War Transport attended by representatives of the London and outport districts and also representatives from Trinity House. The difficulty confronting the Elder Brethren is to maintain the present benefits out of the depleted income consequent upon war conditions, and the London pilots have volunteered an increase in their contribution to the Fund. This alone is not sufficient, and the suggestion has been made that a special rate might be levied for a limited period to be paid direct to the benefit fund.

" A curious situation has arisen on the Humber following the decision of the Humber Pilotage Authority to sanction the employment of unlicensed men to perform pilotage duties within the Humber Pilotage District. This is a revolutionary proposal which is a breach of the provisions of the Pilotage Act, and is one which could not operate without the agreement of the Humber pilots, who would be entitled to supersede any unlicensed man piloting within the limits of the district. The pilots maintain that if additional pilots are wanted the usual war-time procedure of issuing temporary licences should be followed, and they are not prepared to lend themselves to any proposal which is *ultra vires* the Pilotage Act. Representations have been made to the Authority on the matter."

Belfast Harbour Staff Changes

Retirement of Chief Engineer

The retirement, after 52 years' service with the Belfast Harbour Commissioners, is announced of Mr. William Young Chamberlain, Assoc.M.Inst.C.E., who has successively occupied the positions of Assistant Engineer and Chief Engineer. During his tenure of office, he took part in many important improvement schemes for the development of the port, particularly as regards the formation of the new Herdman Channel, 1¼ miles in length, with a depth of 31½-ft. at high water, leading to the new Pollock Basin and Dock. He was also responsible for the construction of the new Aerodrome.

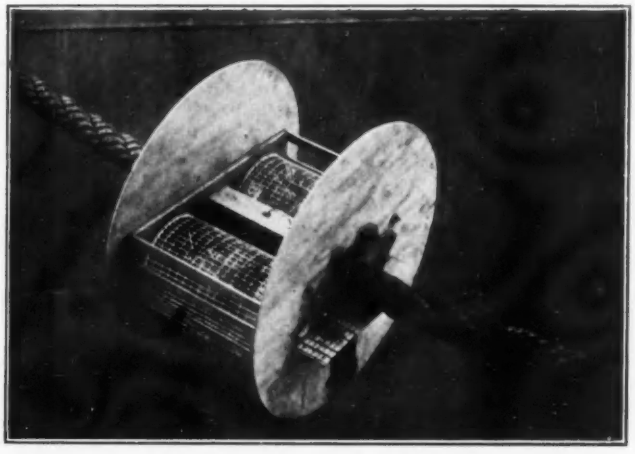
His successor is Major J. H. A. Patton, who joined the service of the Board twenty years ago and latterly has been Assistant Harbour Engineer. Major Patton at the outbreak of the war was called to the colours with the Royal Engineers, but in view of the importance of the work at Belfast, was permitted to return to his civilian duties.

Dockside Rats

The Position in War Time: Increase of the Black Ship Rat

By ERIC HARDY, F.Z.S.

There are two or three important aspects of dockside rats that have arisen during the war. First, the blitzing of many rat-proof warehouses, the fact that ports are carrying bigger food stocks than usual, and that cargoes are coming from new and widely separated ports where rat infestation is often severe, often in ships not normally adapted for that particular cargo, have tended to increase the rat population and to increase its roaming tendencies. Secondly, there has been a very definite increase of the numbers and proportion of the black ship rat at many British ports in the past ten years or so, as if this species is passing through one of those biological cycles of fertility and abundance. Thirdly, many of the useful rat poisons, like strychnine, cannot be used when there



Ship mooring rope with rat-trap affixed. The rat on attempting to board or leave the ship enters the trap and cannot escape.

is so much foodstuff lying around, and many safe, imported rat poisons, like red, squill are almost impossible to obtain. Likewise many rat-proofing materials, like metals, are difficult or costly to acquire. And to this we must add the Ministry of Food's Infestation Order, 1941, which came into force in January, 1942, giving the Ministry power to close warehouses containing infested foodstuffs until steps have been taken to deal with the infestation. Warehousekeepers may be required to take steps to cleanse warehouses, vehicles etc. upon infested premises. This applies also to insect infestation. One or two examples of food cargoes which arrived at British ports last year contained what might have developed into serious insect infestation but for prompt measures. Now that stocks are generally larger than usual and are being held in warehouse longer than usual, the vermin problem may gain a hold. The new Order will have to be enforced rigorously if it is to be effective, and in the ports it is only by co-operative effort under a scientifically organised plan that the wartime rat population can be kept under control. For the past generation we have merely kept the rat population at bay, but it still fights back with its army undefeated. If we are no worse, we are no better than we started.

The position of the increased numbers of black ship rats—an increase which is more of a proportionate one over the numbers of common brown town or sewer rats, than one of dockland catches—has aroused many suspicions of its effects upon health owing to the agency of this rat in carrying bubonic plague, a disease that has seen outbreaks in modern times in Hong Kong, Bombay, San Francisco, Sydney, Adelaide, Liverpool and many Oriental ports. But as I pointed out in a paper on the subject in "The Lancet" recently, there have been instances where the particular plague flea, *Xenopsylla cheopsis*, has been found on this rat in the port of Liverpool, but there has been no danger of plague because the fleas were not infected. It is the flea the rat harbours which carries the germ and may migrate to man. Many rat catchers are at a loss to identify the true ship rat from the brown rat, for despite their names, colour is not always a safe guide. We have known white specimens of the black rat and some very dark brown rats. The best guide is the tail, which is as long as (female) or longer than the body (male) in the black or ship rat and shorter than the body in the brown rat. But in most ports there is a more varied rat population than the inland towns, and more than one kind of ship rat may occur, but they are generally all Oriental tree or climbing rats, which may thus enter a "rat-proof" warehouse via the roof or some pipes, cables, etc. They are less carnivorous than the brown rat.

When I was looking at the Ministry of Food Rodent Officers' investigation returns, I was surprised to see that the Ministry's printed instructions are still out of date in the naming of rats. The three rats we get in Liverpool are: The black ship rat *(Epimys rattus rattus)*, which differs from the brown rat by its smaller slender size, (about 7-in. long), thinner and larger ears, more pointed head, longer whiskers, prominent eyes, and longer tail especially in male. It has a sharper muzzle projecting beyond the lips; it rarely burrows and for that reason when it infests dockside buildings it is generally found in the walls, ceilings or on roofs, and not in the cellars and drains. It is the common house-rat of tropical Asia where buildings are wooden not stone. The Alexandrine rat *(Epimys rattus alexandrinus)* which is also a common ship rat, slighter, browner on its back, and with strongly contrasting pale buff or light grey underparts. It is really a sub-species of the black rat and although these two sorts interbreed freely, they do not breed with the common brown rat. There is also the sub-species of ship rat (*res rattus concolor*) of Burma and Java. The brown rat *(Epimys norvegicus)* is the common town or land rat of Europe and America, also known as the Norway rat, sewer rat, grey rat, etc. There is a black variety called the Irish rat. An excellent swimmer, it makes much use of town sewers for movement from one district to another and many warehouses are infested by old or defective drains that are not made rat-proof. There is no room for me to deal with rat-proofing here, but there are many good books on the subject and it simply means the sealing up with ½-in. heavily galvanised mesh wire, metal or cement all means of access to a building, or between rooms, ceilings etc., by drains, ventilators, pipes, windows, conveyors, door bottoms and corners, cork insulation to chill rooms, etc. In wartime very good rat-proofing substitutes can be made of asbestos and three-ply-wood.

The brown rat will consume anything edible, but although a very experienced rodent officer recently expressed his view that the rats depend very largely upon the faeces in sewers for their subsistence, I hardly think this is the reason for their haunting the sewers. It is, I am sure, one of movement by the most convenient methods according to their underground habits. Brown rats are not dominant in Asiatic towns because sewers are fewer. Less timid of man than the ship rat, they are nevertheless cunning to trap or poison without skill. White arsenic is the best poison after strychnine, for in small amounts it can be made quite safe. Most dockside authorities use far too few traps, and not sufficiently fresh bait. Of course fumigation with sulphur fumes, or in less confined spaces with HCN gas, is a very efficient method of rat control. but wartime air raid rubble is proving a veritably inaccessible breeding haunt with the present shortage of labour and of skilled rat catchers. Fumigation is however the ideal for ships. Ten times as many traps as rats are not too many on a warehousing estate, and rat-guards should not only be attached to ships' mooring ropes, but to wall pipes, cables and other methods of climbing. Many traps will prove effective if set skilfully in rat runs without even bait. For poisoning, the best method is to bait heavily as the favoured spots with food other than locally available—e.g. fish or bloater paste or dripping where there is grain, or rolled oats elsewhere, and then after a few days attracting the rats to come regularly to this favourite feeding spot, put down some bait poisoned.

But all this is useless unless there is a co-ordinated plan, for in the close community of a town reinfestation is so rapid. The best method is to combine proper rat-proofing of all buildings, with fumigation of all known breeding haunts, and persistent

Dockside Rats—continued

trapping or poisoning to keep the animals down. The brown rat is .9-in. larger than the ship rat—but with its tail shorter than the body; reddish-brown or grey on the back, silver-grey on the belly; ears, feet and tail are flesh-coloured; muzzle blunt, ears rounded, feet large or long, head large and body stout.

Brown rats produce eight to ten young in a litter and so many as four litters in a year, ship rats 7-9 young and two or three litters; brown rats breed from six months. Asiatic in origin, they have been made cosmopolitan in distribution through the agencies of commerce and transport and they increase because there are not sufficient natural enemies in their adopted haunts to keep them in check. No doubt we could get rid of the rat menace if the whole world worked on one unified, persistent and intense effort to eradicate the pest; but there are too many neglected centres of breeding which rapidly repopulate the rest of the world. The conditions of wartime favour the rat, despite the increase of organisation to check it. There are too many people shirking their responsibilities: too few traps at warehouses: too infrequent changes of bait: too few trained members of the staff dealing solely with rats. We must raise the status and the pay of the rat-catcher to a skilled occupation.

In the Port of Liverpool, trapping success has been obtained with spring traps baited with ham, bird lime traps, barium carbonate poison baits and caged traps set with gloved hands to avoid leaving a scent. Two methods have been following for fumigating ships because trapping and poisoning cannot completely de-rat a ship. Sulphur dioxide is cheap, safe and easy to handle, but has the disadvantage of corroding metal, it leaves an objectionable odour on bedding, upholstery, etc., and is not suitable for passenger accommodation, and the heavy gas difuses slowly and may damage many articles of cargo. Fumigation with this is most satisfactory when the ship is empty of cargo. The practice was to use 2½ to 3 lbs. of sulphur per 1,000 cu. ft. and close down the spaces under sulphur dioxide for 8 to 12 hours. Up to 3% concentration of sulphur atmosphere in the hold is more important than the method of producing it—by machine, burning pot, candle or condensing bottle. In many aspects, however, hydrocyanic acid gas (HCN) is the better ship fumigant, as it works quicker with a period of exposure of only 2 hours, with no objectionable smell, and it clears rapidly; but it is very dangerous to human beings and has no warning odour except a very slight smell. Following the U.S. Health Department's rule that all ships trading between the U.S. and foreign countries must have all parts, including first and second-class on large liners, fumigated simultaneously with HCN once in six months. Liverpool introduced the method to British ships when the *Scythia* and *Baltic* were so treated here in 1922. Water-tight oak barrels, pitched inside and of 40 gallons capacity, were used, and for each 1,000 cu. ft. space 5 ozs. of sodium cyanide and 7½ ozs. of commercial sulphuric acid and 10 fluid ozs. of fresh water were allocated. A barrel can do 45,000 to 135,000-ft. of space, the water going in first, then the sulphuric acid is carefully added, but the reaction with the sodium cyanide is so rapid that this has to be added in a concentrated solution through a hose or by a cable release from a container so that all men are safely away, unless they wear gas masks. The barrels are stood in the wings of the hold, public rooms, and alleyways.

When a ship arrives in port, sample rats should be caught from all parts and submitted to bacteriologists for routine tests, and especially any sick or dead rats found during discharge of cargo. Dock quays and sheds should be trapped and searched and dockside refreshment rooms are big rat attractors. An examination report should be made on ship for signs of rats by the quantity of excreta, its fresh or stale state, runs, holes, damage to cargo or gnawing at woodwork. Experiments feeding wild rats in cages showed that an extraordinarily large number of droppings is passed in 24 hours, especially on a grain diet, and a rat may pass 33 to 164 droppings a day, so that unless this is known a false suspicion of rat infestation may be made from droppings alone. Bosun's stores, and wooden deck sheds are also rat haunts.

A vessel should be breasted at least 6-ft. from the quay, and ropes, hawsers, etc., should be parcelled and tarred daily as well as rat-guarded. The gangways should be lifted at night. Large crates in the hold should be left until the completion of fumigation, for in one vessel several rats were found in 12,000 bags of cotton seed. Even the use of HCN does not always destroy every rat in the cargo before discharge.

Inspection is specially necessary with vessels trading with plague-infested ports, and the pilot going aboard should gain a history of the vessel and any cases of unusual sickness, or sick rats found at sea. His list of plague ports should be amended according to current information of outbreaks of plague, cholera and yellow fever, at different ports in the world.

In a recent paper in *The Naturalist*, C. Matheson, of the Welsh National Museum, gives some information about ship rats at Cardiff and Bristol, showing that at the latter port from 1929 to 1940, number of ship rats decreased from 1,001 to 677, but at Cardiff the animals are extending their range from dockland to the city proper; the numbers caught in the city were increased from 37 in 1928 to 570 in 1940. In the City of London the ship rat is now the commoner species of the two, according to M. A. C. Hinton, of the British Museum, and probably encouraged through its climbing abilities by the increased use of telephone cables and the reduction of brown rats, which compete with it. In Liverpool, I find that between 1912 and 1918 the peak numbers of rats caught on ships were in 1914 and 1916, on the quays in 1916 and 1917. In the year 1918, April was the peak month and November the minimum for rats caught in the port area, but for the city area the corresponding months were May and December.

In 1930, ship rats were most numerously caught in January, less numerously in December. On ships, January and December saw the largest and smallest trapping returns; on quays, the maximum was in February, and in warehouses, in May. A few brown rats have been caught on the ships, but seldom more than four in a month, so that they are probably only accidental.

In Liverpool in 1929, 10 rat catchers caught 8,088 black rats and 90 brown rats in the port area, and 1,946 black rats and 14,542 brown rats in the city area. Taking the special areas separately, this was made up as follows: Ships, 6,742 black rats (maximum April, minimum August) and 9 brown rats; quays, 938 black rats (maximum August, minimum February) and 52 brown rats; other places in the port area, 368 black rats and 29 brown; city warehouses, 1,676 black rats (maximum May, minimum November) and 3,196 brown rats (maximum May and minimum August); sewers, no black rats, but 6,013 brown rats (absence of black rats is due to their climbing, not underground, habits); other city places, 270 black rats and 5,243 brown rats.

Cargo Handling at the Port of Hull

The Necessity for Acceleration

Addressing the Hull Chamber of Commerce on March 22nd, Mr. D. Bulay Watson, Regional Director for the Humber Ports, made a statement respecting his official duties and emphasised the importance of celerity in the turn-round of ships in port.

In the course of his remarks he said that, although it might seem unnecessary to allude to the need for expedition in connection with shipping, yet he felt the situation justified him in doing so. The shipping losses had not been published for some time, but it had been clearly indicated by Ministers and by the Cabinet itself that the shipping position was extremely serious, and in carrying out his duties as Regional Port Director he could not for one moment allow monetary or commercial interest of any party to be taken into consideration. In any case where this would impinge upon the war effort every day, every hour saved in the turn-round of a ship was a direct increase in our potential shipping capacity. Many of them might be apprehensive as to the precedents they might be setting up or might have a fear of post-war repercussions. They had an Act of Parliament which gave them protection. It was only by ruthless determination to overcome every obstacle that we could be sure of retaining our freedom.

Capstans for Docks and Harbours

The Application of Haulage Appliances to Quayside Work

By J. DALZIEL, M.I.E.E.*

THE CAPSTAN has long been known as an appliance whereby to lift or haul heavy weights through considerable distances by means of a rotating drum. Generally, in the original form of the appliance, the rope was not fixed to the drum, but passed round it with such a number of turns as to ensure sufficient friction grip to produce the requisite pull.

Original Form of Manually-Operated Capstan

The ship's capstan is the progenitor of other and succeeding types and was used more especially for working the anchors, though also for rope haulage generally. It had a vertical bollard and was operated in early, and particularly sailing-ship, days by man power, applied through a multiplicity of long bars or levers inserted in holes fitting them loosely and suitably spread round the circumference of the bollard. Each lever was manned by a number of men who walked round the bollard as hauling proceeded.

The row of holes was generally placed at the top of the bollard which provided for the bars standing waist high, conveniently for the men applying pushing power to them, though this had the disadvantage of the bars being in the way of rope turns being added, if required, to those already round the bollard. Generally the bollard was also fitted with a ratchet wheel and pawl to hold it and the rope if, and when, it was necessary to remove the bars or otherwise cease hauling. Such capstans were also used, and in the case of small harbours still are, on quay sides and pier heads.

Quayside Work

In modern ships, with power-operated appliances, anchor lifting is frequently done from horizontally-place power-driven bollards or winches, but haulage in coming alongside or leaving quays is very generally provided for by vertical bollard capstans, power operated, by steam originally, but in recent years generally electric.

In some few cases, similar capstans up to 15 tons haulage capacity or more are fixed on the dock side shore for similar purposes of ship haulage and these together with examples of capstans similar to theme will be referred to later.

Capstans for Traffic Handling

Dock capstans for traffic handling are closely allied in their purposes, operation, and design, to those used in railway sheds and yards. The latter were probably the first to be evolved, with the object in the early days of replacing animal power, later to take the place of locomotive shunting, and also, in combination with traversers and turntables, to provide means of working wagons to points not otherwise conveniently accessible, and allow of such wagons, after loading or unloading at such points, being worked away therefrom without obstruction to further traffic coming on to be dealt with.

Such capstans for wagon haulage in both dock and railway yards are fitted with vertical bollards of much smaller dimensions than those of ship and ship-haulage capstans and have in the prevailing form loose ropes and a rated pull of about one ton. This pull, especially in the case of electrically-operated appliances, can, if desired, be much exceeded and sometimes is, but for loose rope work, one ton or at most 30 cwt. is as high a rated pull as should be used on account of rope dimensions and breakage and as will be seen anything higher leads to difficulties and is generally undesirable.

In general form such capstans, which used to be practically universally hydraulically operated, consist of a box, generally of cast iron, sunk in the ground so that its top surface is flush therewith and containing the machinery driving a bollard of waisted shape.

The bollard is always flared out at the bottom and in most cases is also flared out to a less extent at the top, but is sometimes straight vertically for some considerable distance up to near the top where it is flared out for a very short distance only and with no great increase in diameter. On the writer's experience, the form with a distinct waist half-way up with an appreciable flare above as well as below gives the best results on loose rope capstans, whereas on capstans of the free bollard type (described later), having the rope fixed to the bollard and wound round it, a form having a considerable vertical length of straight uniform diameter gives the best results. There are few, if any, free bollard hydraulic capstans.

Medium Shallow-type Capstans. Motor with high resistance rotor and limited torque.

The bollard runs at a speed, light, of about 90 to 100 revs. per minute, and at its minimum diameter of about 13-in. to 15-in. gives a orpe speed, light, of roughly about 350-ft. per minute. This comes down to about 160 to 180-ft. at rated pull and the bollard should stall on heavy load. The height is generally about 20-in. to 24-in. which is convenient for manipulating the rope and throwing fresh turns round the bollard.

In the waisted type for use with the free rope, the flare above and below the minimum diameter should be just sufficient to ensure the rope slipping vertically as haulage takes place, so as to keep the 4 or 5 turns more or less in the same position in the vicinity of the waist.

Though there may be some few examples of dock and railway haulages operated from horizontal bollards, the advantages for such purposes of the vertical bollard in allowing ropes to be operated from any point all round are manifest and a further advantage is that of its allowing the operating machinery and its own anchorage and foundations to be below ground, presenting no obstruction to traffic or other movement in the yard or to the manipulation of its ropes.

Generally speaking, access to this operating machinery is provided by openings covered by plates fitted into suitably recessed framing. These plates in many designs are bolted down on rubber or other jointing material to ensure water-tightness, but the effect of this is to make them very heavy and difficult to lift single-handed. The writer prefers to make these plates of chequer plate type, light and easy to manipulate, so that there is less temptation to leave the underground machinery uninspected and unattended for over-long periods and to take any risk there

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Capstans for Docks and Harbours—continued

may be of ill-effects due to ingress of water. There is, of course, no special necessity for making hydraulic capstan boxes watertight.

The underground box should in any case be well ventilated and its bottom should be gently sloped so that water drains to one end, where a sump connected to a drain can be provided. The drain, may, however, defeat its own purpose by allowing water to back up and in the case of some capstans, dealt with by the writer, providing for shunting the tracks serving a quay wall, the sump was drained by a pump worked off an eccentric mounted on the horizontal first motion shaft, the capstans in question being electric. The pump in such cases should be self-priming when there is water for it to handle, but should be capable of running dry without detriment for long periods when there is not. There is no necessity for any such arrangement when a drain can be provided with which there is no liability to water backing up and flooding the capstan box.

Hydraulic capstans are, in general, operated by 3 or 4 rams and cylinders working direct on to crank pins on the vertical bollard shaft, an opposed ram design being frequently used, so that there are only two cranks to four cylinders.

The vertical crankshaft is held in a footstep bearing mounted on the bottom plate of the capstan box; the upper bearing comes inside the bollard and should be carried well up its vertical length, preferably to a point above the waist where the weight of the main pull is taken.

The top of the capstan box should, of course, be reinforced to carry this bearing accordingly, and at this point the box is generally cast in a form to produce a flanged girder.

The footstep bearing is, in general, of the usual type, brass or white metal lined and oil or grease lubricated. The top bearing is frequently lubricated from the centre of the top of the bollard down through the shaft, but it can, of course, be greased lubricated from underneath. There is no gain to be made by providing ball or roller or other elaborate bearings in the hydraulic capstan, the appliance in itself being very wasteful of power and the speeds being very low.

In the case of some hydraulic capstans, the bollard, together with the bearings of the bollard shaft and its cylinders and rams, are all carried from a section of the top plate which swings on trunnions so that the whole plate can be turned over to bring the operative cylinders, etc., up for inspection, adjustment, packing and so on. This is called the turnover capstan; the pressure water is fed to the cylinders (which are oscillating) and the exhaust taken away from them through the trunnions at either end; the cylinders are generally three in number, working on to one crank pin, which is overhung so that no footstep bearing is required; the upper bearings are strengthened accordingly.

Hydraulic Operation

Dock capstans were originally hydraulically operated universally and were, of course, supplied from the general system of hydraulic mains from which the whole installation of machinery at the docks was worked.

Hydraulic capstans are still used in very large numbers.

The supply mains may or may not comprise a return water main, it being a frequent practice to use dock water and to discharge the exhaust water from individual machines into the dock at the nearest convenient point. This saves an extensive installation of return piping, but it frustrates the possibility of providing cheaply for adequate lubrication of the capstan or other machinery which is effected generally by adding a proportion of soft soap to the water, and the cost of maintaining valves, cylinders, rams and packing is materially enhanced accordingly. This is all the more so in cases where the water is pumped from the dock, as it is liable to be brackish or salt, which in itself is worse from the lubricating point of view than fresh water is even without soap.

Most hydraulic capstans for traffic haulage purposes are fixed bollard loose rope type for a rated pull of 1 ton.

The operating valve is generally of the balanced type worked from a foot pedal.

Generally, a moderately skilled operator can obtain a wide measure of speed control by manipulation of the pedal but the writer has never been able to get a definitely expressed opinion from traffic officers as to whether this is necessary or even advantageous. To provide for it has practically no effect on the design of the hydraulic capstan, but it does, or would, create a problem and occasion additional elaboration of design and multiplication of apparatus in an electric capstan.

In general, the afore-mentioned bollard speed, light, of a hydraulic capstan of approximately 100 revs. per minute or thereby, for reasons which will appear shortly, should not be exceeded and in some instances a diaphragm with a suitably-sized opening is inserted in the pressure water feed pipe to ensure this. The efficiency at no load is not only obviously nil, but it is at this load that the capstan makes its maximum demand for power on the mains and this may be as high as 80 h.p.

Working Characteristics. Replacement of Hydraulic by Electric Capstans.

Speed falls off as load is imposed; the maximum pull is, of course, limited by the working volume swept by the driving rams and the bollard will stall at a pull of about 3 to 5 times the rated pull. This falling speed characteristic of the hydraulic capstan, makes it highly suitable for the work to be done as it obviates snatch on and breakage of the rope and provides for gradual acceleration of the hauled wagon train with speed increasing as pull falls off. In view of the importance of the work and the conditions of its being done effectively the wastefulness and high power consumption of these appliances is a secondary consideration to their suitability. When, however, it comes to a question of it being feasible to substitute electric power for hydraulic this wastefulness points the way to considerable economy in total power consumption by the substitution, in the case of capstans in extensive use, especially where these are largely operated on light loads, of electric capstans for hydraulic. Otherwise, in such conversion cases it is frequent to find the hydraulic machinery mainly retained and electricity simply applied to the driving of the pressure water pumps.

Apart from their high power consumption on light loads, such as hauling in slack, hydraulic capstans have the great advantage of robustness and comparative simplicity. They are their own effective controllers of overload, limited by the water pressure and the area of the operating rams, and they have sufficiently ample overload capacity in correspondence with the cylinder capacity requisite for maintaining reasonably high speed on full load pull. On the other hand, it is this which causes them to be heavy consumers of water, and as they haul through distances far greater than those, say, of cranes, the load is more sustained and in general, the capstan load exercises a considerable bearing on the total demand for pressure water to be met by the pumping station. This is less so probably in the case of most docks than in the case of a goods yard, there being in general at docks a much greater number proportionately of heavy machines taking water in large volumes.

The simplicity of the controlling apparatus, that is, a balanced valve operated by foot pedal, is contributory to the simplicity of the capstan as a whole and the enclosure of the water in the cylinders when the valve is closed, applies a holding means to lock the bollard which has to be replaced in the electric capstan by a special brake. This also ensures the bollard stopping on release of the pedal within the 1½ revolutions prescribed by regulation for safety reasons.

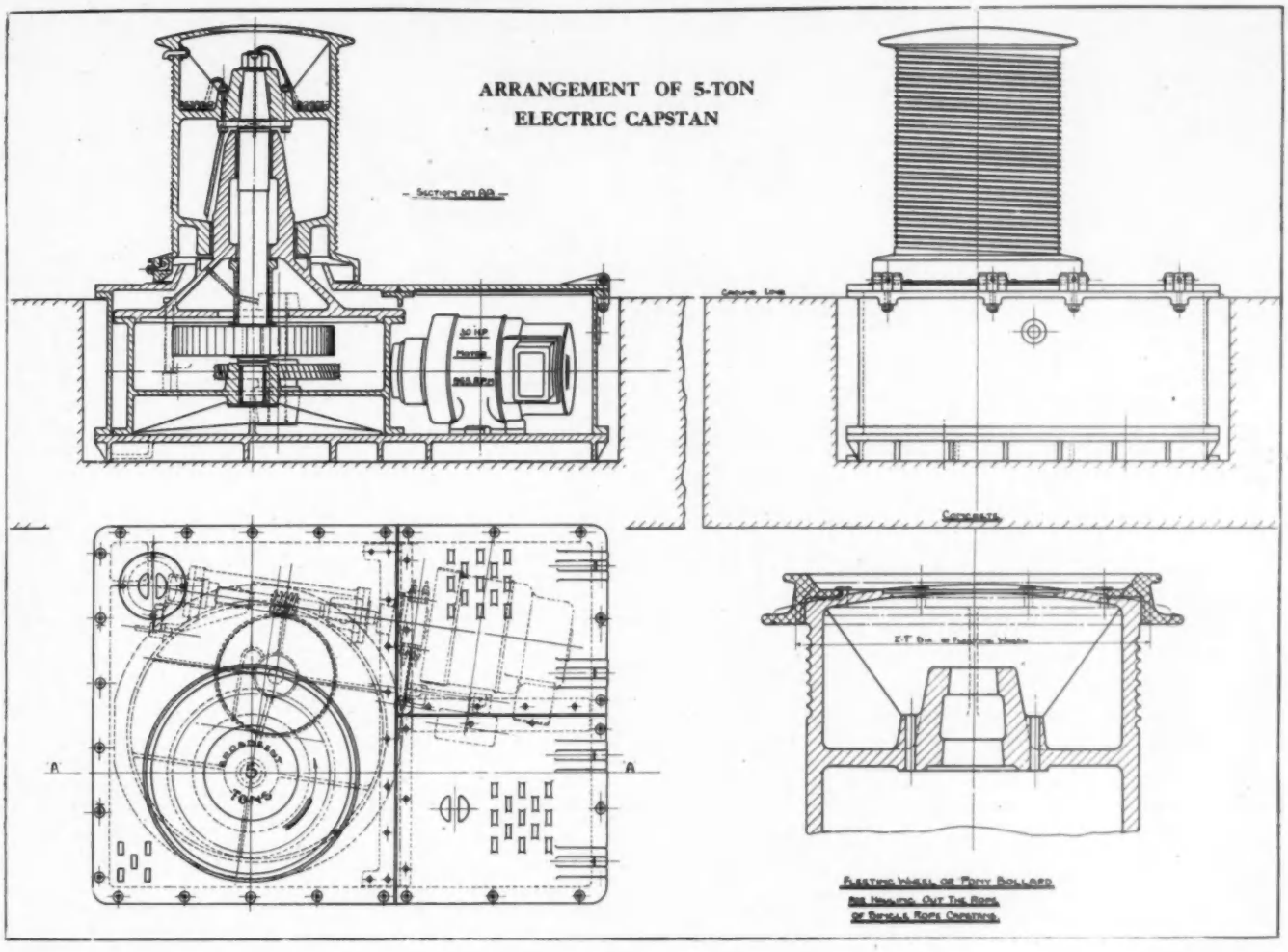
Electric Capstans

The advantages of electric capstans over hydraulic type are enumerated below, but briefly lie mainly in their much greater economy of power and in their direct use of electricity, which as a source of distributed power supply is now of much wider availability, application, and adoption than hydraulic power.

The electric motor, in its D.C. form especially, is inherently of much greater overload capacity and maintains speed on overload to a much greater extent than in the case of the hydraulic capstan; this applies likewise, but to a less extent, in the case of the A.C. motor.

Advantageous though these characteristics may be, however, in the case, for example, of traction motors and motors applied to the operation of constant speed machines running for long periods,

Capstans for Docks and Harbours—continued



they are not entirely advantageous in the case of capstans. It is a further drawback to the electric capstan that, as compared with the simple valve of its hydraulic rival, its control involves switch gear of greater or less complication and expense in initial and maintenance costs. This applies particularly in the case of D.C. capstans. Electric apparatus is also obviously more vulnerable to the effects of wet or damp conditions than are hydraulic appliances.

It has already been indicated that the speed pull characteristic of the hydraulic capstan, with its fall of speed as pull increases and its gradual acceleration, is ideal for capstan work in easing rope snatch, preventing rope breakages and obviating jerky handling of traffic. Hydraulic capstans therefore set a standard to which electrically operated capstans should conform. It may, of course, be asked why, with the hydraulic capstan providing working conditions so ideal for the purpose, electric operation should be considered at all. The answer lies as above-mentioned in the modern universality of electric supply, in its advantages of application, its economy over long ranges of loading, and its low cost of generation and/or purchase as compared with hydraulic power in all but a few instances. The effect is that nowadays its adoption in preference to hydraulic power, or for that matter any other form of power distribution, is practically automatic.

Electricity, however, is produced and purchasable in various forms, more particularly direct current and alternatively, three-phase alternating current.

These forms have particular fields of application in which their characteristics are specially suited to the operations to be performed. For example, the series wound direct current motor has outstanding advantages in the application of electricity to traction, crane operation and the like; the falling speed torque characteristic of the motors which renders it so, presents attraction from the capstan point of view and resembles the characteristic of the hydraulic capstan above referred to, but the rise in torque is more considerable and the fall in speed less in the case of the electric capstan with the normal motor. There is no question of the capstan stalling, as does the hydraulic machine when subjected to an overload not so much in excess of normal full load as to be seriously harmful to the ropes.

The fall in speed of the series D.C. motor, could, however, at the expense of economy, be exaggerated by any desired extent, including stalling at a certain load, by winding the motor to have a high resistance or inserting an external resistance permanently in series with it.

While this, as will be shown, corresponds to what has proved successful practice with A.C. motors, it is not normally necessary with series or compound wound D.C. motors as sufficient protection to the ropes is afforded and sufficiently gradual starting and acceleration is attained by the utilisation of the standard falling speed characteristic of such motors in combination with overload cut-outs; these latter, of course, add to the complication of the switch gear.

In general, on D.C. capstans it is desirable to make the motors compound and not straight series wound, in view of the amount of light running to be done and the liability of the capstan on light load with a straight series motor to run up an excessively high speed. Even so, the fall of speed with rising load can be made quite considerable. Moreover, the starting resistances which must be provided with a D.C. motor in any case, if properly

Capstans for Docks and Harbours—continued

combined with suitable switch gear, can be utilised to provide graduated starting.

Resistances should, in any case, be made of sufficient capacity not to be damaged by over-heating if left in circuit under either light or heavy load.

The original electric capstans had series wound D.C. motors which were started from a foot pedal, operating a switch arm traversing a number of resistance contacts, the pedal lifting a weight which returned the switch to zero point on its release. This had a number of disadvantages, for example, the pedal could be depressed too quickly and the switch arm could be worked or left in a position half-way between contacts, causing these to burn and require renewal. In the original capstans, also, if it were not fully depressed, the resistances were overheated and damaged.

Only a very partial improvement is effected by fitting a dash-pot to the switch arm, preventing it from being moved over too quickly. A further improvement is for the pedal to be pushed down to its full extent in the first instance and without restraint; the switch arm, following down under the influence of another weight and therefore at a more or less constant rate of resistance being cut out.

In general, an overload cut-out was fitted to these capstans in all their various forms; usually this cut-out automatically re-set itself on the pedal starting lever being returned to the off position.

It was frequent, in early cases, to provide a second and final cut-out which, in the event of the operating cut-out going repeatedly, would finally interrupt the capstan circuit in a way to necessitate the electrical staff being called in to re-set it and make the capstan again operative. This is no longer necessary.

The final form of switch gear for these D.C. capstans comprised a small number of contactors, say 4, cutting out resistance in steps, the contactors being operated from a small pilot pedal-operated switch. This latter had, of course, to handle only the current of the actuating coils of the respective contactors; one of the objects of using it was to enable the contactors proper to be either wholly or partly actuated by full or partial depression of the pedal with the object of giving speed control on the capstan motor. As already indicated, the writer has never been able to find a traffic officer who would make a definite demand for such speed control though its advantages, discussed theoretically in the air as it were, were repeatedly stressed.

Brakes in early capstans were electro-dynamic, that is the braking effect was obtained by appropriately connecting the field and armature across resistance or short circuit. This had the disadvantage that it did not lock the bollard, and that it might not operate at low speeds below the self-excitation speed of the armature; otherwise it was quite effective.

Solenoid operated brakes releasing the brake weight on the operation of the pedal were later fitted and fulfilled the conditions of locking the bollard and stopping it in 1½ revolutions.

Later, especially in the case of A.C. capstans, where the actuating solenoid is more complicated and expensive than with D.C., the brake weight was lifted off and re-applied as the pedal was actuated and released.

A brake of appreciable power is essential in any case as apart from the necessity, for safety reasons, for stopping the capstan in 1½ revs. it may be necessary to hold a set of wagons on an incline with the bollard at a standstill, or to keep the springs compressed. The bollards of electric capstans are generally operated by the motor through worm gear, but a quick thread worm can, of course, be driven back by the load.

The amount of switch and other gear connected with starting and operation of D.C. capstans makes them costly as compared with hydraulic capstans, both in first and maintenance costs. As capstans they are satisfactory under the conditions above described, and they are suited to varying conditions of load, for example, where both heavy starting torque and heavy pull at fairly low speeds are required, and a fast speed at light load is necessary, as, for example, in connection with traversers, where the wagons have to be propelled on to the tables up ramps and also in connection with turntable work.

The construction of these capstans is very much like that of the hydraulic capstans, except that in the early days there was a tendency to make the containing boxes very large.

This could not very well be avoided on D.C. capstans, more particularly of the type evolved in the early stages with all the gear contained in the boxes. A reduction could have been effected as in later periods by mounting only the pilot switches for pedal operation in the boxes and putting the contactors, starting resistances, and the like in some convenient adjacent position above ground where they had the advantage both of increased accessibility for maintenance and of better conditions as regards damp, etc., though at the expense of increased wiring.

The use of standard motors, either A.C. or D.C. would require that the box be of appreciable depth in any case. This is especially so if the motors, for example for 1-ton capstans of some 15 to 20 h.p. have to be of this power on the 1-hour rating. Such a rating period is, and has proved to be, suitable for much larger motors for traction and also for cranes, and the like, (though for these latter it is frequently over-generous) but according to the writer's experience a rating of full load for ¼ hour with a temperature rise of 90° F. ensures a sufficiently large motor for capstan work. Later, therefore, on the railway with which the writer was primarily connected, namely, the Midland, special motors were designed for both A.C. and D.C. capstans which stood very low and enabled capstan boxes to be made of very shallow depth, rather less in fact, than that of the so-called shallow type hydraulic capstan. Capstans of this shallow type were necessary for use in the intermediate floors of double deck warehouses and sheds, and as the capstan so produced proved quite a satisfactory one, the type was standardised for all purposes.

In the D.C. case the low design of the motor was attained by making the machine 4-pole, but with two field coils only, mounted on salient pole pieces on either side of the armature with two consequent poles top and bottom, bored out of the field frame.

The A.C. motors presented a different problem as the rotor had, of course, to be embraced uniformly all round by the stator. In their case the diameter of the motor and the radial depth of the stator were selected to suit the available height, the requisite material for the power being worked into the motor by suitably dimensioning the length axially. These motors were, however, in any case, special in other respects as will be explained later.

The gear between motor and bollard is practically universally on 1-ton capstans, worm and worm wheel, having ball or roller thrust bearings; as the speed ratio is not very great and the worm can consequently be conveniently made quick thread, the efficiency of the drive as a whole is high. On heavier capstans of higher haulage capacity and more especially at lower rotative speeds, spur gear reduction is frequently combined with the worm gear.

The brake is generally of the band type, though sometimes employing cast iron or other brake blocks; the band or blocks engage in general with the coupling between the motor and the worm drive.

The bollard shaft is carried in a foot-step bearing fitted on the bottom of the capstan box and as in the hydraulic case a substantial cross-member at ground level carries the upper bearing of the bollard shaft, which correctly, but not always, is carried well up to take the side stress of the load of the rope pull as directly as possible.

Three-Phase Capstans

With the advent of general adoption of three-phase current, accompanying the wider spread of the use and availability of electric supply, and resulting from its simpler and cheaper distribution in commercial form, its application direct to capstan operation as to the operation of other machines and classes of machinery, became an important desideratum. The standard three-phase motor for starting against loads and that taking the minimum starting rush current was originally the wound rotor machine in the case of which resistance was inserted in the rotor circuit by means of slip rings and brushes and was gradually cut out by a multi-point starting switch in the same way as in the case of the starting resistance of a D.C. motor, but with the added complication of the switch dealing with three circuits instead of one.

Capstans for Docks and Harbours—continued

Excepting in so far as the starting resistance controlled the speed of rotation, the motor was of constant speed and had no inherent falling characteristic as in the case of series or compound wound direct current motors. Obviously, the switch gear was no less but rather more complicated and expensive than in the case of D.C. motors and the motor tended to be larger and did not lend itself to any modification in shape so as to reduce the height or other accommodation required in the capstan box.

In the early days for these and other similar reasons, including the lower overload capacity of the three-phase motor, such motors were regarded less favourably than the D.C. machines.

So far as starting and overload capacity went, the wound rotor and slip ring machine was, however, good enough for capstan and most other work. In comparison, the squirrel cage motor was an infinitely simpler machine, but it was a poor operating motor, having even with a very high starting current a comparatively small torque, so that it was unable to start against full load; even when started it had a comparatively low overload capacity. On the other hand, it was found as it became better understood, that its starting and other switch and precautionary gear could be greatly simplified in comparison with either the three-phase slip ring or the D.C. motor and finally, as power station and distribution system capacities increased, it was found permissible in the case of such motors, even up to comparatively large sizes, to switch them direct across the mains.

The motors themselves were robust to a maximum extent, the rotor windings, in particular, consisting of solid bars soldered, brazed or welded into solid rings at either end, insulating material being practically absent. Furthermore, the stator windings are to a great extent, self-protected by their inductive effect, being such as to prevent current of value high enough to be harmful over any short period, passing into them, though they would, of course, be liable for damage were the maximum current under stalling conditions to flow for any length of time. It is, however, for this very reason that the motor has nothing like the overload capacity of the D.C. motor and in fact, under stalling conditions, the power factor is zero, except for the resistance component.

These factors of the squirrel cage motor conferring the use of a very robust motor largely capable of being its own safeguard against overloads, and permitting of its being started by the use of a switch throwing it directly across the line, fitted with overload gear, if fitted at all, only as a final precaution against stator breakdown, led to its adoption, first of all by the railways themselves as a standard type of motor for capstan use. It did not, however, prove that this led to a final solution of the problem. Obviously the characteristic of the capstans so operated was not the speed-falling one of the ideal hydraulic type, and the same capstan could not meet heavy pull low speed requirements and light load high speed ones such as in the latter case were required for turntable, traverser and similar working. It was necessary, therefore, to differentiate between these requirements and to fit differently geared capstans for the respective situations.

It was also found, particularly on low periodicity 25 cycle supplies, that the haulage rope could not be controlled satisfactorily by slipping a rope, due probably to the maintenance of speed arising from the constant speed characteristic of the motor; it was found that the rope either failed to grip the bollard at all or with an additional turn of the rope did not slip at all with resultant snatch and rope breakage. In the case of 25-cycle supply, in fact a curious phenomenon was experienced in that the rope developed a rapidly periodic jerking or sawing motion which was too hard physically on the capstan men for them to be able to work the capstan satisfactorily or to make any attempt at slipping the rope. It was never clear why this effect should make itself felt to such an extent on 25-cycle current and not seriously on 50-cycle, but the capstans had to be made to work on the former periodicity, so that this, together with the reduction of rope wear and breakage, and the improvement of speed characteristic, presented problems still to be solved.

As already indicated, it was not of any vital importance that a motor highly efficient in current consumption against duty should be used, the energy consumption of electric capstans being almost negligible in any case as compared with that of hydraulic. The essential feature was that of suitability for duty.

After the conditions, together with various alternative proposals had been fully considered, it was decided to fit to the motors, rotors of such high resistance as to stall them down to zero speed on overloads of 100 to 300% (which could be pre-arranged) and definitely limit them in torque accordingly. This met the problem of providing the requisite falling speed characteristic to correspond with the ideal characteristic of the hydraulic capstan and was also found to eliminate the sawing motion above referred to at 25 cycles, and stop snatch and rope breakage. It had the effect of starting the load away gradually from zero speed, especially on heavy pulls and the capstan was, in fact, capable of hauling on a dead load, that is with the bollard stalled, for an appreciable period without damage or bringing out the overloads.

At the same time, obviously, considerable heat was developed in the rotors which transmitted itself to the stators and it was found advantageous in manufacturing these motors, to build up their windings with special varnish and to embed the windings in a solid insulating plaster.

Free Barrel Capstan, 15-cwt. rated pull.

It was found unnecessary to build capstans for different speeds according to duty, as above described, with capstans of this type, the high speed type being capable of being adapted for both sets of conditions. Though it tended to accelerate constantly on heavy loads it did not do so rapidly enough to bring up the speed of a heavy raft of wagons beyond a suitable limit.

The speed drop due to the resistance of the rotor, of course, contributed to this, whereas on light single wagon traverser and turntable loads practically full speed was attained almost immediately.

It will be appreciated that the aim in designing and adopting this type of capstan motor was that of evolving a simple hard duty machine requiring a minimum of accessory gear and having a characteristic suited to the work without much regard to current economy.

The high rotor resistance feature was utilised in motors for other industrial purposes by various makers, though not generally until some time after its adoption on these capstans. In some cases the well-known "skin" effect is used to increase the resistance at starting, leaving it to fall as the rotor speeds up. This is an effect of self-induction which at the high periodicity of the magnetic flux in the stationary or slow running rotor prevents it (i.e., the flux) from penetrating into the interior iron and inducing current in the deeper seated portions of the conductor bars or windings, thus making them partially ineffective and increasing the resistance accordingly. This increase may be enhanced by making the conductors near the surface at the top of the slots of higher resistance than those lying deeper. As the rotor speeds up the periodicity of the flux in relation to individual conductors decreases and with it the inductive or "skin" effect, and the deeper-seated conductors commence to carry full current. Such a motor is highly applicable where, as is very general, starting is

Capstans for Docks and Harbours—continued

the principal problem, but is in a general case, less suitable for capstan work where the rotor resistance should remain high throughout to give the requisite speed drop with load.

Apart from the heavier self-induction of the slip-ring motor which helps to limit rush current, much the same resistance results on the characteristic could be obtained from slip ring motors with resistance connected between the slip rings. The squirrel cage motor is, however, much the simpler both in respect to the motor itself and its appurtenances.

It is certainly some disadvantage that the resistance heat in its case is developed internally to the motor itself, whereas the heat developed in external resistance can be kept away from the motor.

A falling characteristic can also be obtained by inserting resistance in the main or stator motor circuit inasmuch as torque falls off as the square of the reduction in applied E.M.F., but this is less effective than when the resistance is in the rotor circuit and with it there would be even heavier rotor currents and little less rotor heating. As already indicated, with suitable varnishes and solid insulation of the coils the motors will stand up satisfactorily to the heating effects produced under all normal conditions of the operation of the capstans.

Conditions of Changeover from Hydraulic to Electric Operation

Though the loss of efficiency is appreciable, it is not so great as to prevent such capstans showing a wide margin in their own favour in energy consumption as compared with hydraulic capstans and as already indicated, where change-over from hydraulic to electric operation of the machinery of a dock or of the hydraulic pumps from steam to electric is in consideration, the comparative economy of electric capstans argues in favour of their substitution direct for heavily operated hydraulic capstans, so as to reduce the demand for hydraulic power and the capacity of the pumping plant required.

Generally, a considerable proportion of the hydraulic demand of a railway yard arises from a few machines, among which are generally a number of heavily-operated capstans; the conversion of these machines has, in the writer's experience, reduced the hydraulic load by half. This is unlikely to be quite the same in connection with dock plants, as here the main demand frequently arises from a number of machines, such as coaling plants, in heavy and continuous operation, making much larger individual demands than is the case in railway yards.

(To be continued)

Obituary

Mr. John Hannay Thompson, O.B.E.

Less than a year after his retirement from the service of the Dundee Harbour Trust, to which he had been chief engineer for forty years and general manager, in addition, for thirty, Mr. John Hannay Thompson, O.B.E., M.Sc., M.Inst.C.E., J.P., has died at his home in Broughty Ferry, at the age of 72.

After education at Trinity College, Harrogate, and at the College of Science (now Armstrong College), Durham University, Mr. Thompson began his engineering training with the Wallsend Slipway Company, afterwards passing into the employment of Messrs. Sir John Coode, Son and Matthews, of Westminster. He was appointed engineer at Dundee in 1901 and General Manager in 1909.

Many improvements were carried out under his direction, notably the construction of the electrically equipped King George V Wharf, one of the best deep-water quays in the country.

During the last war Mr. Thompson was asked by the Government to report on engineering and financial questions affecting the " mystery port " of Richborough. He frequently gave evidence before Committees of the House of Commons, in the Law Courts and Court of Session, and before the Royal Commission on Coast Erosion. A great believer in the wider dissemination of technical knowledge, his services in this field were twice recognised by the French Government. He was made an Officer d'Academie in 1920 and received the Insignia of the Palmes d'Officier de l'Instruction Publique in 1936.

Corrosion Proof Buoy Attachments

A recent issue of *World Ports* contains a description of a method adopted on the Pacific Coast to protect chain moorings from galvanic action in sea water.

At an experimental installation in San Francisco Bay during the development of Westinghouse seadrome contact lights, the engineers found that these floating buoys could not be securely moored in position with iron chains. The uppermost links in the iron chains were eaten away and the buoys released.

Investigation further revealed that galvanic action had taken place in the bronze " eye " of the metal basket which houses the battery case and lamp assembly, thus causing the separation from the iron anchoring chains.

The use of *lignum vitae* as a connecting link was ruled out on account of liability to *teredo* attack, while rope links were insufficiently durable.

It was therefore decided to try industrial Micarta, a laminated plastic moulded from sheets of cloth impregnated with phenol-formaldehyde resin. Strips, 2-in. wide and 18-in. long, were sawn from ¾-in. plate and U-shaped metal yokes—bronze at one end of the strip and iron at the other—were affixed to the experimental " links," thus separating the bronze and iron members of the buoy assembly.

After eight months' service, the buoys were raised and the Micarta links examined. The plastic was found undamaged, though covered with marine growth, barnacles and *teredo*. Galvanic action, however, had ceased. Although *teredo* were probably attracted by the slight phenol flavour in the sea-water close to the plastic, they had not been able to penetrate or even scar the Micarta links.

Cardiff Shipowners and Port Working

At the recent annual meeting of the Cardiff and Bristol Channel Shipowners' Association, Sir William Reardon Smith, who was re-elected chairman, emphasised the importance or surveying " not only the sea-going operations of their ships, for which they were directly responsible, but also other questions for which they were partly responsible and certainly vitally interested, such as loading and discharging and repairing, and it was in these many and varied operations that they found cause for serious misgivings. For a long time past, many of them felt the maximum effort had not been put forward. It was not for them to apportion blame, but they did say that much more could be done, and should be done, in the grave national emergency."

Sir William gave it as his opinion that:

" More ships could have been built, more ships repaired, and more ships loaded and discharged in the same given time, if determination and willingness had been shown on both sides to forget past squabbles and disputes, and work solely for the national interest. If there was slackness, inefficiency and lack of interest on the part of the management, let it be shown up, and whatever the outcome dealt with effectively and promptly. If, on the other hand, there was slackness, inefficiency, obstruction and arbitrary rules reducing output, let them be dealt with without fear or favour. It was for the majority of employers and men, working in complete agreement, and supported by a Minister of National Service, not a Minister of Labour whose bias invariably appeared to be against the employers, to get together and show the country what could be done in the way of complete co-operation."

The Future of Ocean Leviathans

Is the Big Ship Obsolete?

By "HELIOS."

Post-War Conditions as Affecting Ship Design.

It is somewhat futile to speculate too deeply as to post war conditions, but there is one subject at least to which harbour engineers may devote such little spare thought as their more pressing occupations may permit, viz.: will the pre-war tendency for ship's dimensions to increase continue? During the war of 1914-1918 there was a great destruction of shipping and afterwards there was a very definite leap upwards in dimensions, culminating not long before the present war in the building of several 1,000-ft. ships which were much advertised and by their prestige drew to them a large fraction of the Transatlantic passenger traffic. It has not been stated to what extent they adversely affected the use of less celebrated vessels, but it may be conjectured that there was such an effect. This on the face of it suggests that the very big ship meets a further want, but the basic question is not simple. As to cargo ships, a comparable increase in size occurred, but the actual dimensions reached were quite modest as compared with those of passenger ships. It may also be observed that the draughts of even the new passenger ships have not again reached the maximum of about 42-ft. which had been earlier attained. Taken in conjunction with the magnitude of the efforts required to provide this draught in the great canals, harbour approaches and berths, it may fairly safely be assumed that the limit of draught has been reached. A large part of the geometrical advantage of further increasing size thus disappears, since the skin area per unit volume of a solid of which only two dimensions increase, is constant and not a diminishing value, as it is where all three dimensions increase. It is true that the volume per foot run of berth still grows with the breadth of ship.

Points in Favour of Large Vessels

The paramount advantages of the larger ship are as follows:—

(1) Reduced numbers and therefore charges for crew and their accommodation per ton or per passenger. This is often offset by the introduction of special services.

(2) Reduced response to sea motion, somewhat increasing comfort of travel. This is only a marginal effect since the greatest reduction in mobility is between, say, 5,000 and 15,000 tons, and is often offset by the height to which the large ships are built, thereby increasing windage.

(3) More volume per passenger, allowing the provision of more amenities and better ventilation.

(4) The prestige of "giantism" accruing to the ship, the line and the nation, and supposedly bringing its reward in greater purchasing power.

The last two matters are probably much overdone and it is very dubious if the post-war conditions will permit such waste of effort.

(5) The reduced propulsive power per unit volume, which however depends on draught increasing with the other dimensions.

Counter Considerations

Against the large ship are the following items:—

(1) Greatly increased costs of harbour facilities (depend mainly on draught).
  (a) Dredging in berths and approaches.
  (b) Depth of wharves.
  (c) Dry docks.
  (d) Cranes.

(2) Limitation of routes

(3) Concentrations of hazard (collisions, fire, mechanical breakdown, storm and war).

(4) Reduced hatch area per unit of volume, involving longer "turn around" (depends partly on draught).

(5) Increased inertia, reducing controllability and enlarging the effects of collision, especially in the smaller vessel.

(6) Longer building time.

(7) Special building berths required, involving extra dredging and special tools, etc.

(8) Large movement in fore and aft parts of the ship.

(9) Much vibration due to lack of stiffness.

(10) Difficult to tow if disabled or when berthing, involving increased handling charges.

(11) In passenger ships, many inside cabins.

(12) Monopolising large frontage of wharf.

The subject is controversial, but perhaps the foregoing statement of pros. and cons. may be helpful to an appreciation of the question at issue.

Notable Port Personalities

XXII—Sir Thomas Howard Elderton

Sir Thomas Howard Elderton, Kt., Chairman of the Calcutta Port Trust, India, was born in London in 1886. He is the son of the late William Alexander Elderton and was educated at the

Sir THOMAS HOWARD ELDERTON, Kt.

Merchant Taylors' School and Clare College, Cambridge, where he graduated B.A., First Class, in the Mathematical Tripos, 1908.

His official career with the Calcutta Port Trust commenced in 1909, when he was appointed Assistant Secretary. In 1914, he became Deputy Secretary, and Secretary in 1918.

He was elected Deputy Chairman of the Board in 1924 and he has been Chairman since 1932.

Sir Thomas served (1915-1917) with the Third and Seventh Bedfordshire regiment in the last European War.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in this Journal should not be taken as an indication that they are necessarily available for export.

Launching Slipways for Vessels

An Article for Students and Junior Engineers

By STANLEY C. BAILEY, Assoc.M.Inst.C.E., F.G.S.

Lateral Launching

As most shipbuilding yards are situated along the shelving banks of tidal rivers on alluvial soil, the construction of the permanent shipbuilding slips, or launching ways, generally involves heavy piling of the foundations in order to support the keel blocks during the construction of the vessel, and to carry the launching weight of the ship on the fore and aft cradles and sliding ways which are situated at a distance of from 7 to 12-ft. or more from the centre line on each side. Medium sized and small ships are still launched sideways, but this involves a considerable waste of foreshore space in the shipyard, and all cranes and scaffolding must be removed on the river side of the ship before launching. It is a convenient way of launching in narrow rivers, but may involve additional dredging along the foreshore; a greater number of ways will be required and, if placed 30-ft. apart, they will usually be of less total length than for end launching. The *Great Eastern* steamship, 692-ft. by 83-ft. beam, and 58-ft. depth was launched sideways with some difficulty at Blackwall on the River Thames in 1858, but most ships are now launched endways, with the bases of the stern cradles just above the high water spring tide level of the river.

Endways Launching

The sliding ways should not be constructed at right angles to the river bank, unless it is a wide one, but at angles of from 15 to 30 degrees from the normal, to direct the vessel down stream; this is especially necessary in narrow rivers, so that the vessel when afloat, will not, while pulling on the bow drag chains, foul shallow water, or the opposite bank, but can be directed into the main deep water channel of the river.

The standing, or ground, ways are constructed at an inclination and distance apart suitable for the class of ship usually built at the particular yard. The lighter the weight of the vessel, the greater is the slope given, because the sliding force increases with the inclination and is in direct proportion to the weight; it acts parallel to the surface of the plane, and the friction is directly proportional to the pressure, irrespective of the area required by the weight. In Fig. 1 A, if W = the weight, and P = the pressure on the inclined plane; then S = the sliding force, and if a = the angle of inclination of the plane, then $P = W \cos a$ and $S = W \sin a$.

Friction

The co-efficient of friction for a vessel sliding on greased timber-ways varies from 0.03 to 0.04 at starting to 0.02 and 0.022 afterwards, and the effect on vessels of 1,000 and 6,500 tons launching weights will be as follows, viz.: In the case of a ship of 1,000 tons on a grade of 1 in 20, the starting friction may be $1{,}000 \times 0.04 = 40$ tons, and the sliding force will be about 50 tons, but on a grade of 1 in 12, the friction remaining the same, the sliding force will be 93 tons. For a ship of 6,300 tons on a slope of 1 in 20, the friction will be about 260 tons, and the sliding force 300 tons, but on an inclination of 1 in 12 the sliding force will amount to 575 tons; this would cause too great a launching velocity.

The distance apart of the ways is greater for vessels with a wide beam, than for those of narrow beam, and the gradients vary from 1 in 13 for light vessels to 1 in 24 for heavy ones. Some yards have ways suitable for launching merchant ships, battleships and cruisers, in addition to those for smaller vessels, and the inclination given to the ground or standing ways, and their distance apart must be arranged accordingly, but although permanent ways may be constructed at a particular inclination for heavy ships, they can also be utilised for lighter vessels, because the ground or standing ways on which the sliding ways under the ship move, are built up with timber on the permanent ways to any required inclination to suit the particular lighter vessel to be constructed.

The construction of the permanent ways comes within the province of the Civil Engineer, but the standing and sliding ways, together with the cradles and other launching arrangements, are a part of the work of the ship constructor, who will supply the necessary information as to the loads to be carried on the slipway. As the Civil Engineer should have some general knowledge of the methods used in calculating the pressures on the ways, and at what positions in the length, the maximum pressures will occur, a general description will now be given of this portion of the work.

Launching Weight

Most ships when being launched are made so light as possible by the omission of boilers, machinery, smoke stacks, and masts, etc., but the screw propellers are usually fixed, so that it is only the hull without superstructures that is launched, although small coastal steamers and trawlers are often launched complete if the stocks are not immediately required for the construction of another vessel.

The launching weight, including the cradles and sliding ways of merchant ships, varies between 0.372 and 0.569 of the fully-loaded displacement weight, the average for a number of vessels being 0.45 of the displacement weight.

In the case of battleships, it varies from 0.52 to 0.62 of the displacement, the average being 0.57. This is due to the heavy armament plates. In lighter armoured vessels the figures are 0.38 to 0.44. If the gross tonnage is known of merchant ships, the displacement tonnage of ships of about 6,000 to 20,000 tons gross tonnage is equal to the gross tonnage multiplied by 1.37 to 1.44, the average for a number of vessels being 1.40; and for ships of over 20,000 tons up to 80,000 tons gross register, the multiplying figures are 1.06 to 1.18, the average for a number of vessels being 1.12, but the gross tonnage is calculated on measurements made after the ship has been completed.

Thus a vessel 500-ft. by 63-ft. beam and 42-ft. moulded depth and 26-ft. loaded draught, with a gross tonnage of 10,315, would have a displacement weight of about $10{,}315 \times 1.40 = 14{,}441$ tons, and a launching weight of $14{,}441 \times 0.45 = 6{,}498.45$, or say 6,500 tons; this is the vessel that will be considered in the calculations that are given further on.

The weight of 6,500 tons is distributed over the lengths and widths of two sliding ways between each end of, and including the fore and aft cradles. To this load must be added the weight of the ground or standing ways, the platform, beams and piles of the permanent ways, in order to arrive at the loads and piles will be required to carry. This will amount to an average of about 0.25 ton per sq. ft. and may be so much as 1 ton per sq. ft. under the fore part of a cradle.

The cradles, poppets, sliding ways, and standing ways are built up of timbers varying from 12 to 18 or even 24-in. square, according to the size and weight of the vessel to be dealt with. They are fastened together with bolts, steel straps, chains, clamp irons and spikes.

The length of the sliding ways, including the cradles, is usually 0.8 or four-fifths of the overall length, or sometimes the length between perpendiculars of the ship, while the width depends upon the average weight to be allowed per sq. ft., and varies from 2 to 3-ft. for light vessels up to 4 and 8-ft. for heavy ships; the more usual widths are 5 and 6-ft. The average weights on the ground ways ranges from 1 to 3 tons per sq. ft.

As a ship is not an absolutely rigid body, being more or less flexible, it is liable when at sea during stormy weather to become temporarily hog-backed, due to the midship section riding on the

Launching Slipways for Vessels—continued

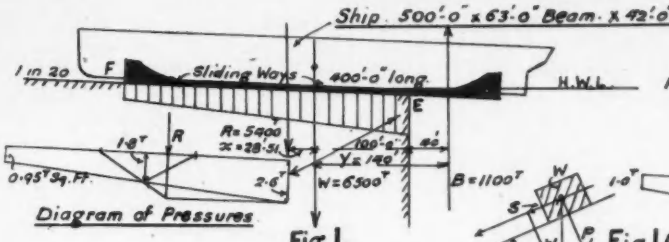


Fig. 1.

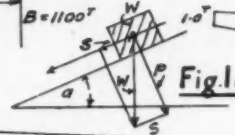


Fig. 1A.

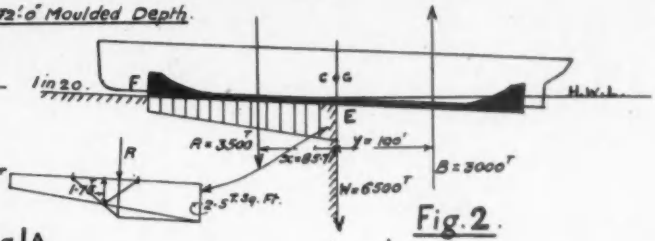


Fig. 2.

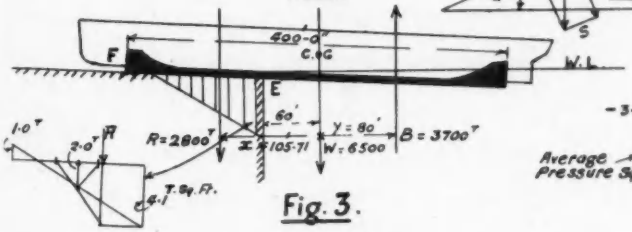


Fig. 3.

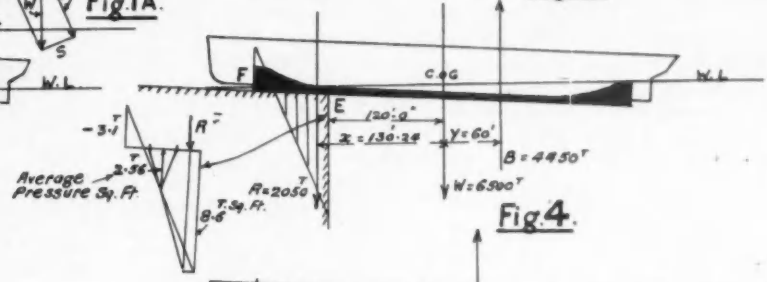


Fig. 4.

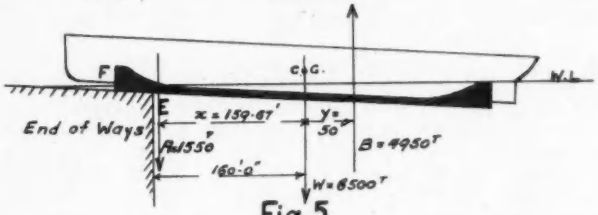


Fig. 5.

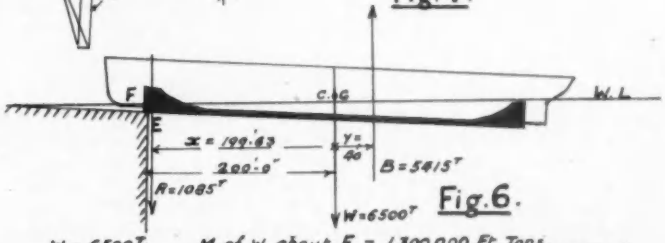


Fig. 6.

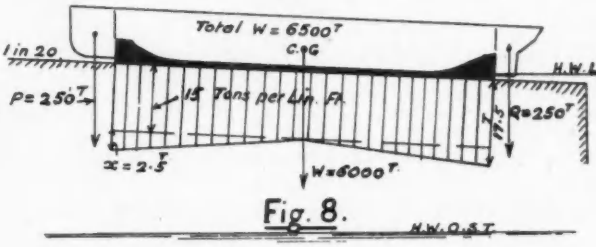


Fig. 8.

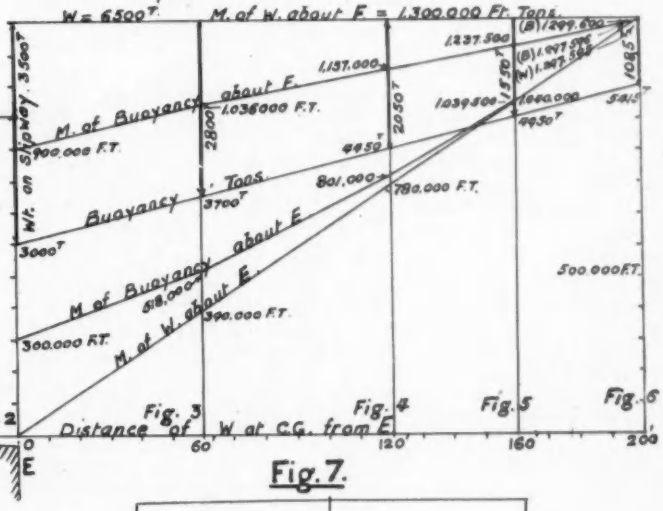
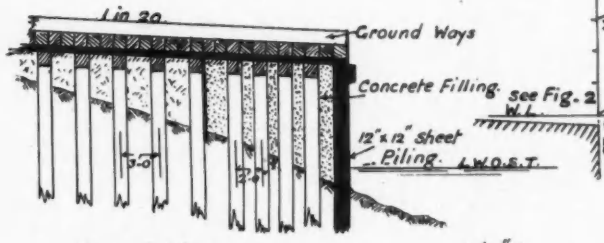


Fig. 7.



End of Ways.

Fig. 13.

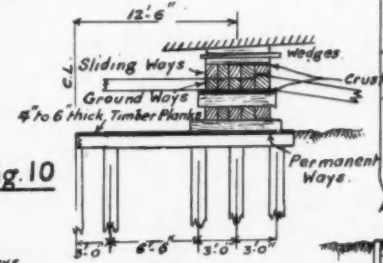


Fig. 10.

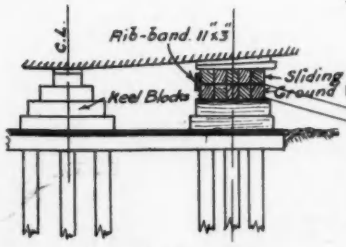


Fig. 11.

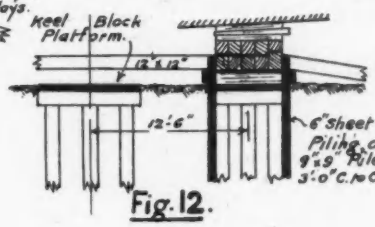


Fig. 12.

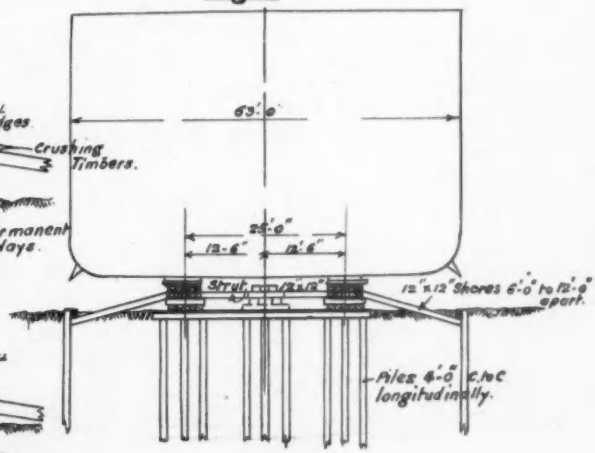


Fig. 9.

Launching Slipways for Vessels—continued

crest of a wave while the bow and stern are in the troughs of the wave. Much the same effect is produced during the launching of the vessel, for the midship section may be bearing on the aft end of the ways, while the bow is only partially supported by the ways, and the stern by the buoyancy of the water.

Also when at sea, the ship may sag amidships, should this portion be in the trough of the waves, while the bow and stern are carried on the crests of waves. The same conditions obtain during launching operations, just before the ship drops off the after end of the ways on which the bow is supported, while the stern is waterborne.

For these reasons, to arrive at the positions of the pressures on the ways at the various stages as the ship slides down, the balancing moments of the weight (W) and the buoyancy (B) must be calculated, and the methods usually adopted for doing this are to treat the forces as an unbalanced couple, the leverage of B being its distance (y) from W at the C.G. of the ship; therefore the moment (M) of B = B.y. The resultant pressure (R) to balance B will be = W—Band it will act at a distance (x) from $W = \frac{B.y.}{R.}$ on the opposite side of the C.G. to that of B, or outside the larger force. Therefore the M. of B. about R = M. of W. about R.

The ship should also be considered as a lever of the second class, with its fulcrum or pivot (F) at the foot of the bow or fore cradles; the leverages for the moments of W and B being taken about F, while the pressure (R) at F = W—B, should the ship povit at that point; but the ship may also pivot on the aft ends of the ways at E should the buoyancy not be sufficient to prevent the bow tipping up, and the whole pressure of R will come on the ends of the ways; therefore the moments of W and B should also be calculated about E.

Figs. 1 to 6 show a ship, of the size and launching weight referred to previously, at various stages during its descent on the ways, the amounts of W, B and R, the leverages, and the pressures on the ways in tons per sq. ft. being shown, while in Fig. 7 the weight, buoyancies, and the moments about E and F are given for the respective positions of the vessels.

In Fig. 1 the resultant R = W—B = 6,500—1,100—5,400 tons, the moment of B = B.y. = 1,100 × 140-ft. = 154,000 ft. tons, and x the balancing leverage of R from $W = \frac{B.y}{R} = \frac{154,000}{5,400} = 28.51$-ft.

The moment of B about F = 1,100 × 340′ = 374,000-ft. tons and the moment of W about F = 6,500 × 200′ = 1,300,000-ft. tons, the length of the ways being 500′ × 0.8 = 400-ft. As the M of W exceeds the M of B, the pressure R of 5,400 tons will come on 300-ft. of the ways, and the average pressure for ways each 5-ft. wide $= \frac{5,400}{300 \times 5 \times 2} = 1.8$ tons per sq. ft., giving a maximum of 2.6 tons per sq. ft. at E, and 0.95 ton per sq. ft. at F exclusive of the weight of the permanent ways, as shown in the diagram.

As the vessel slides into the water, the centre of buoyancy near the stern end gradually moves towards the C.G. of the ship until the vessel has floated on an even keel, when it will coincide with the C.G. line, but will be underneath. Few vessels when launched rest on an even keel, the stern being deeper in the water than the bow, due to the C.G. being usually aft of the midship-section.

As the stern of the ship slides down into deeper water, the resultant R is gradually reduced, and moves away from W at the C.G. towards the bow or fore cradles, and so long as it remains aft, of these cradles, the vessel will be steady on the ways, but should it fall on the forefeet of the bow cradles, or in front of them, the ship will pivot at F and the whole pressure R will be concentrated on the bow cradles. This occurs when the vessel is on the point of slipping off the ground ways into the water.

Should R fall outside the aft end E of the ways, the vessel will stumble and tip up at the bow cradles, and the whole pressure of R will be concentrated on the ends of the ways; this is a dangerous condition, but is only momentary, as the ship travels at the rate of about 1-ft. per second when it begins to move, up to a maximum of 18 to 23-ft. per second, or from 12.27 to 15.68 miles per hour, the whole operation of launching taking about 60 seconds from the time the vessel begins to move.

It is important therefore for safe launching that R should always, when possible, fall on the groundways up to the moment that the vessel slips off the aft end E into the water.

In Fig. 2, the vessel will be almost balanced on the after ends of the ways, giving an average pressure of $\frac{3,500}{200 \times 5 \times 2} = 1.75$ tons per sq. ft.; the maximum at E will be 2.5 tons, and at F it will = 1.0 ton per sq. ft.

In Fig. 3, tne ship will tend to rise at the bow cradles, and pivot at E, the average pressure per sq. ft. $= \frac{2,800}{140 \times 5 \times 2} = 2$ tons, the maximum at E will be 4.1 tons, with a negative pressure at the bow of −1.0 ton sq. ft.

Practically, of course, this negative pressure or tension only occurs to a limited extent, as there is a certain amount of adhesion or suction between the sliding and groundways due to the thick coating of tallow and oil.

In Fig. 4, the ship will tend to rise at the stern and pivot at the aft ends of the ways; the average pressure per sq. ft. will be $= \frac{2,050}{80 \times 5 \times 2} = 2.56$ tons, while the maximum at E will amount to 8.6 tons per sq. ft. and the negative pressure at F will be −3.1 tons per sq. ft.

In all the calculations, as W is at a fixed distance from the feet of the fore cradles at F, the moment of W about F remains constant at 1,300,000-ft. tons.

As already stated, when R falls outside the after end of the ways, the vessel will tip up at the bow cradles, or if as in the curves in the diagram Fig. 7, for ship position in Fig. 5, the M of B about E, intersects the M of W about E, or should the M of B about F, intersect the M of W about F, the ship will be unstable; this is shown to occur in Figs. 5 and 6 and occasionally takes place in launching operations; the bow cradles tip up, and as the vessel slides into the water and the buoyancy increases, the cradles strike the ways and the ship may be damaged.

In Fig. 5, the M of B about F = 1,237,500-ft. tons and that of W = 1,300,000-ft. tons, the M of B about E = 1,039,500, and W = 1,040,000-ft. tons, so that they practically intersect when the C, G of the ship is 160-ft. from E1 and the whole pressure of R = 1,550 tons will come on the ends of the ways. This is not an unusual pressure for a ship of the size being considered, and assuming a bearing 5-ft. in length, the pressure will amount to $\frac{1,550}{5 \times 5 \times 2} = 31$ tons sq. ft.

Tipping of the vessel may be avoided by ballasting the bow end of the ship, but this increases the dead weight and the pressure on the ways, and is not usually done.

Airtight barrels, or camels, may be fixed under the stern. This will answer the same purpose, but there is considerable buoyancy in the stern cradles, and the barrels, etc., would be an obstruction. The underwater portion of the permanent and standing ways may be extended into deeper water; this is expensive, and entails a longer run for the ship.

The gradient of the slipway may be increased. This would cause a heavy ship to travel too fast for safe launching; the best alternative is to camber the standing ways to an arc of a circle, this is the modern practice and involves little extra expense.

By this means, the ship will start slowly, and accelerate in speed as it passes over the arc, the inclination of which at the river end of the ways is from $\frac{3}{4}$-in. per ft. (1 in 16) to $\frac{5}{8}$-in. per ft (1 in 19.2). The buoyancy is thus increased rapidly, the length of run is reduced, also the tendency of the vessel to tip up at the bow, the pressure is reduced on the after ends of the ways, but that at the bow cradles increases when the stern lifts. The amount of camber given to the chord varies from 1-in. to 14-ft. to 1-in. in

Launching Slipways for Vessels—continued

50-ft. length of groundways, and the larger and heavier the vessel, the greater is the camber given. The depth of water over the ends of the ways should be from 7 to 10-ft. In Fig. 6, the vessel is shown at the point at which it begins to drop off the ways; in this case the M of B about F=1,299,600, and that of W= 1,300,000-ft. tons, while the M of B about E=1,297,596 and of W=1,297,595-ft. tons and the pressure of R=1,085 tons will fall on the ends of the ways.

As regards the distribution of the 6,500 tons launching weight of a ship 500-ft. long, which is an average of 13 tons per lin. ft., the weight of the midship section for about 1/3.3 of the length will be about 20% in excess of this, giving a weight 15.6 tons per lin. ft. Assuming that ways 400-ft. long will carry a weight of 15 tons per lin. ft. or a total of 6,000 tons, the overhanging bow and stern will each weigh 250 tons at at P and Q in Fig. 8. To find the additional load per lin. ft. on each of the bow and stern cradles due to the overhangs, make the area of each triangle at the base of the diagram=250, therefore $x = \frac{250 \times 2}{200} = 2.5$ tons, giving a total load of 17.5 tons, or $= \frac{17.5}{1 \times 5 \times 2} = 1.75$ tons per sq. ft.

The distance apart of the standing ways for a ship having a launching weight of 2,400 tons is about 13-ft. centre to centre, up to 25-ft. for vessels of 5,000 to 40,000 tons launching weights.

In Fig. 9 the midship section of a ship is shown on the ways, and Fig. 10 is an enlarged detail of the sliding and standing ways. The meeting surfaces are coated with layers of tallow, soft soap, and train oil up to about 1½-in. in thickness for heavy ships; for loads of from 1 to 2 tons per sq. ft. soft tallow is used, and from 2 to 3 tons per sq. ft. hard tallow, coated with oil.

As there is considerable lateral thrust from the vessel. which cannot be accurately calculated, timber shores are fixed to the standing ways from 6 to 12-ft. apart: these butt against piles and extend for about 2/3rds the length of the ways from the lower end. To prevent the sliding ways from slipping off the standing ways, the outer timber of the sliding ways is made thinner than the corresponding timber of the standing ways, as shown in Figs. 10 and 12 or if they are made of equal thickness, then a timber rib-band 11-in. by 3-in. is fixed as a flange on the inside of the sliding ways, as illustrated in Fig. 11, or on the outsides of the standing ways. In some cases in lieu of a continuous platform across the ways, they are built independently, with sheet timber piling on each side, as shown in Fig. 12, to prevent lateral movement.

Details of Launchways

In order to pull the speed of the vessel up after it enters the water, some hundreds of tons of heavy drag chains, which may amount to 1,000 tons in the case of a large ship, are arranged in coils on each side but clear of the ways near the bow, one end of each coil being attached to the vessel, while the other end is fixed to heavy weights or plates.

The sliding and ground, or standing, ways are usually of pitch pine, but for heavy hulls, the fore sliding ways, and the aft groundways are sometimes made of oak to withstand the heavy pressures.

Fig. 13 illustrates the construction at the aft end of the permanent ways, with concrete filling between the piles to distribute the pressure. An alternative to this is to excavate a pit, drive the piles down, and fill the pit with concrete up to the level of the underside of the groundways; the heads of the piles should project about one foot into the concrete.

(To be continued)

Belfast Quayside Emergency Regulations

The Port Emergency Committee at Belfast has lately ordered that all empty wooden cases for shipment must be " collapsed " before being brought on to the Harbour Estate, by which it is expected that considerable economisation of shipping space will be effected. It has been found that such articles tend to accumulate, as is the case with iron and steel scrap, for which vessels are not always available as rapidly as might be desirable. The Committee has ordered that all goods, including empties, placed on the quays or in sheds must be removed within 48 hours of being laid down, the penalty being rising rents. The " permitted period " (seven days after the final discharge) during which iron and steel landed from a vessel from a coastwise or cross-Channel port at the Musgrave Channel or Milewater Basin are free of quay rent, has now been reduced to 24 hours. Special measures are being instituted to prevent pilfering, a practice which is still far from being stamped out.

New Master of Trinity House.

At a General Court of the Corporation of the Trinity House of Deptford Strond, held on March 29th last, H.R.H. the Duke of Kent was elected Master of the Corporation in place of the late Duke of Connaught and Strathearn. The Court was attended by a number of Elder Brethren, including the Deputy Master (Captain Sir Arthur Morrell), the Marquis of Crewe, Earl Baldwin, Viscount Runciman and the First Lord of the Admiralty (Mr. A. V. Alexander).

Bravery Award to Dry Dock Manager.

Mr. Lewis Trenchard, Manager of the Cardiff Channel Dry Docks and Pontoon Co., Ltd., has been awarded the M.B.E. for heroism at the time of an explosion in a ship undergoing repair. Disregarding his own safety and without waiting for a gas mask, he rushed to the rescue of several men whom he succeeded in lifting to a hatchway before he himself was overcome by smoke and fumes.

Improvements at Danish Port.

During the coming summer certain improvements are to be carried out at the Danish port of Odense at an estimated cost of 1,340,000 kroner. The work includes extensions of the existing quayage and deepening of the approach channels.

New Grain Elevators in Argentina.

The announcement has been made in Buenos Aires of the intention of the Argentine Government to construct 64 new grain elevators, having a total shortage capacity of 150,000 tons, to serve the port shipment districts of Rosario, Santa Fé, Villa Constitucion, Buenos Aires, Quequen and Ingenieso White (Bahia Blanca). Work is to be put in hand forthwith, the estimated cost being 11½ million pesos. This undertaking will form the first instalment of a project for the erection, at an estimated cost of 25 million pesos, of 250 elevators with a storage capacity of 350,000 tons. The elevators will be designed to three standard types of 5,000 tons, 2,700 tons and 1,500 tons capacity respectively.

Swedish Port Finances.

The deficit of the budgets of Swedish ports is reported to be causing some anxiety; it is estimated that the total deficit of 44 Swedish ports will be 3.5 million kroner more than in 1942 than in 1941. Receipt of ports in South and Central Sweden were 3.3 per cent. less in the second half of last year than in the corresponding period of 1940 and 48.5 per cent. less than in 1939. Receipts of West Coast ports were 42.7 per cent. more than in 1940, but 52.8 per cent. less than in 1939. The receipts of ports in North Sweden were 37.4 per cent. less than in 1940 and 14.5 per cent. less than in 1939.

War Traffic at Egyptian and Middle East Ports.

An official statement issued at Cairo announces that over three million tons of military stores, including a million tons of food, have been landed at Egyptian ports since the war started. Regarding Middle East, it states that " old ports have been developed and new ports and jetties constructed, some of which are in the nature of an insurance against interruption of the present supply routes. The turn-round of ships has been speeded up so that liners can turn round in two days."

Notes of the Month

Tees Conservancy Commission.

Sir William Crosthwaite, Mayor of Middlesbrough, has been elected deputy-chairman of the River Tees Conservancy Commission.

Death of Retired Harbour Master.

The death is announced of Captain Chas. B. Cotterell, who was harbour master at Southampton for 32 years. He retired from active service in 1932.

Portrush Harbour Chairmanship.

Mr. Samuel Berkeley, managing director of the Belfast Steamship Company, Ltd., has been elected chairman of the Portrush Harbour Company in succession to the late Mr. Robert Darragh.

New Panama Canal Locks.

The U.S. House of Representatives has approved an expenditure of upwards of a hundred million dollars for the Panama Canal development works, including 57 million dollars for a new set of locks.

Promotion of Inland Waterway Traffic in United States.

The United States Government is taking every possible step to encourage the use of the Eastern Intracoastal canals and inland waterways in order to relieve the transport situation. A large number of wooden barges are being built in default of supplies of steel. Concrete barges are not in favour as wooden barges are easier and cheaper to construct.

Tribute to Dock Workers.

A tribute to the exertions of dockers at British ports was recently made by Lord Woolton, Minister of Food, who said: "Never a ship comes into this country with food but the Ministry is watching to see how long it is to be before it is unloaded and away again to get more. The speed with which dockers in some ports have been unloading food shows that they are doing a grand job. I want, as Minister of Food, to praise the dockers."

Formation of Southampton Dock Labour Board.

A Dock Labour Board has been appointed for the Port of Southampton under the National Dock Labour Corporation, Ltd. The Constitution of the Board is as follows: Messrs. H. A. Short, chairman, with J. Buchanan, E. Burrow, L. A. Burton, R. Chick and C. E. Cotterell. There is one seat vacant. The officers of the Corporation at Southampton are: Manager, Mr. R. J. Howell; accounting officer, Mr. W. A. Boden; port labour officer, Mr. John Hart.

Belfast Harbour Board.

Sir Ernest Herdman has been re-elected chairman of the Belfast Harbour Commissioners for the 16th year in succession. He has been a Commissioner since 1904, stated to be the longest period on record.

Erosion of Banks of River Humber.

The Humber Conservancy Board have had under consideration a report from the Lindsey County Council on the subject of the erosion of the banks of the River Humber, but before taking action it has been decided to await the result of representations made to the Government.

Channel Development at Cleveland Harbour.

The Rivers and Harbours Committee of the U.S. House of Representatives has approved certain measures for the improvement of Cleveland Harbour on Lake Erie. The work will include the extension of the Cuyaloga River Channel for a distance of 500 yards upstream.

Repairs to Port of Hangö.

A report is included in the Helsinki Journal *Hufvudstadsbladet* stating that repair work at the Port of Hangö in Southern Finland, damaged during hostilities with Russia, is progressing rapidly and that fairly large vessels are able to use the port, where cargoes are transferred to smaller vessels for forwarding elsewhere.

Dock Labour Scheme at Lincolnshire Ports.

A Dock Labour Scheme for the Ports of Grimsby and Immingham came into effect at the end of March. The scheme is on similar lines to those already introduced at larger ports, and for its administration the Local Board appointed by the National Dock Labour Corporation, Ltd., is as follows: Messrs. E. Sutcliffe (chairman), J. R. Bailey, F. Simpson, T. W. Sleeman, C. L. Surfleet, P. G. Tripp, and W. F. Trought. The local manager appointed by the Corporation is Mr. J. James.

Developments at Port of Baltimore.

The United States Board of Engineers for Rivers and Harbours has recommended to Congress the improvement of Baltimore Harbour and its approaches by deepening the main channel from the ocean to Fort McHenry, by dredging an additional anchorage area 1,200-ft. by 2,400-ft. to a depth of 30-ft., by dredging a connecting channel 400-ft. wide and 27-ft. deep from Cut-off Brewton Angle in the main channel to the Inland Waterway from Delaware River to Chesapeake Bay and by dredging a channel 200-ft. wide by 35-ft. deep in Curtis Creek.

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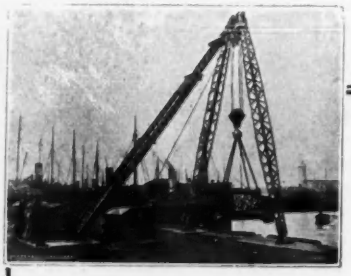

25-Tons Shear Legs at a Scottish Harbour.

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